MILWAUKIE STORMWATER MASTER PLAN

September 2004

Prepared for:

CITY OF MILWAUKIE

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SECTION 1 - INTRODUCTION

In the June of 2003, the City of Milwaukie began developing a stormwater master plan to replace the surface water master plan developed by Montgomery Watson (1997). This document is the new stormwater master plan.

The stormwater master plan has several objectives:

- Develop a plan that enables the City to meet its existing and future storm drainage/flood protection needs.
- Address stormwater quality issues and hence support compliance with associated regulatory requirements such as the underground injection control (UIC) requirements, the municipal national pollutant discharge elimination system (NPDES) stormwater permitting requirements and the total maximum daily load (TMDL) requirements that are expected for Johnson Creek, the Willamette River, and eventually Kellogg Creek.
- Evaluate the existence of barriers to fish passage and the potential for removal of these barriers in order to address habitat issues associated with anadromous salmonids that are listed as threatened or endangered under the federal Endangered Species Act (ESA).

To meet these objectives, the study covers the piped stormwater system with diameters equal to or greater than 15 inches within the City of Milwaukie limits. However, the study did not evaluate flooding along streams and open channels, as agreed to with the City, since survey data for open channels and streams was not available. The system was evaluated with respect to capacity using XP-SWMM, a hydrologic/hydraulic model. A portion of the City's stormwater runoff drains to the piped system and the remainder from the eastern and central portion of the City discharges into 188 drywells that are maintained by the City. Drywells are essentially bottomless catch basins or manholes that extend into the permeable subsurface gravels that underlies the City. A separate study was conducted by the engineering consultant HDR, concurrent with this study, to evaluate the City's drywells with respect to meeting Underground Injection Control (UIC) requirements.

At the City's request, URS conducted a field reconnaissance focused on identifying conditions and opportunities to improve fish passage in the Spring Creek subbasin of Johnson Creek. Spring Creek is located wholly within the City of Milwaukie, and thus provides an opportunity to affect change throughout a system. The stream is highly visible to residents, school children, and visitors to Scott Park, creating a potential for public involvement and watershed stewardship education, in addition to providing benefits to listed fish.

The model results, the UIC study results, and the Spring Creek field reconnaissance results were compiled and reviewed in light of NPDES requirements, TMDL requirements, UIC requirements, and funding issues to develop a storm system capital improvement plan for the City.

The remaining sections of this Milwaukie Stormwater Master Plan are organized as follows:

- Section 2.0 includes a brief summary of the City of Milwaukie study area characteristics that are relevant to the storm drainage system.
- Section 3.0 describes the evaluation methods used to develop the stormwater master plan.
- Section 4.0 describes the selected management alternatives (i.e., Capital Improvement Projects (CIPs)) that are proposed to address the expected flooding, water quality, and fish passage issues identified in Sections 3.0.
- Section 5.0 describes the prioritization of the selected management alternatives for implementation.

SECTION 2 – STUDY AREA CHARACTERISTICS

This section provides a summary of the citywide study area characteristics relevant to the storm drainage system.

STUDY AREA LOCATION

The City of Milwaukie is located in the northern section of the Willamette Valley and on the east side of the Willamette River as shown in Figure 1. The study area comprises approximately 4.8 square miles located in northern Clackamas County.

RAINFALL

The average annual precipitation for the City of Milwaukie is approximately 47 inches. Approximately 70 percent of the total precipitation falls from November through March. Precipitation in the summer months is in the form of showers and/or thunderstorms.

LAND USE

The City of Milwaukie is mostly developed (see Figure 2). It is expected that approximately 0.5% of the City is currently remaining for new development. Land use consists of residential (low, moderate, and medium density), commercial (including high density), industrial, public, and town center as follows:

Land Use Type	Percentage of City
Residential	68.5
Commercial	3.5
Industrial	18.3
Public	6.7
Town Center	3.0

SOILS

The predominant soil types in the City of Milwaukie are made up of Latourell and Quatama loam, Woodburn silt loam, and Wapato silty clay loam. The Latourell loam formed in stratified glaciolacustrine deposits and has moderate soil permeability. The Quatama loam formed in stratified glaciolacustrine deposits and has moderately slow soil permeability. The Woodburn silt loam formed in stratified glaciolacustrine deposits and has moderate soil permeability. The Wapato silty clay loam formed in mixed alluvium and has moderately slow soil permeability.

TOPOGRAPHY

The City of Milwaukie encompasses a "bowl " area located between Minthorn Creek and Johnson Creek; this area is where the City's drywells are located. The southwest part of the City slopes downward toward the south, with elevations ranging between approximately 20 to 170 ft.

DRAINAGE SYSTEM

The City's storm drainage system includes approximately 25 miles of stormwater pipe and open channel systems, 596 manholes, 5 detention ponds, and over 1600 catch basins (see Figure 3). Approximately 22 miles of stormwater pipe (15-inch diameter pipes and greater) in the study area was modeled for the stormwater master planning effort. The piped system conveys stormwater away from developments and discharges at major outfalls located on the Willamette River, Johnson Creek, Kellogg Creek, and Mount Scott Creek (a tributary of Kellogg Creek).

Stormwater runoff from the eastern and central portion of the study area discharges to the subsurface through 188 city-owned drywells. The locations of the drywells are shown on Figure 3. The drywells are generally located in the area between Johnson Creek and Railroad Ave. The surface elevation where these drywells are located varies from 100 to 190 feet mean sea level (msl). The drywells are used to dispose of runoff from rooftops, driveways, and roadways. City drywells are typically of 20 to 25 feet deep (City of Milwaukie's UIC Program Evaluation, 2004).

WATER QUALITY

The Oregon Department of Environmental Quality (DEQ) has the responsibility for developing water quality standards that protect beneficial uses of rivers, streams, lakes and estuaries. Once standards are established, the state monitors water quality and reviews available data and information to determine if these standards are being met and water is protected. Section 303(d) of the Federal Clean Water Act requires each state to develop a list of water bodies that do not meet standards. The list serves as a guide for developing and implementing watershed pollution reduction plans to achieve water quality standards and protect beneficial uses. These watershed pollution reduction plans are referred to as a total maximum daily loads or TMDLs.

The City of Milwaukie stormwater piped system includes major outfalls that discharge into three water bodies that are listed in DEQ's 2002 303(d) list. The 303(d) list includes the following parameters of concern for Johnson Creek, Kellogg Creek, and the Willamette River.

Parameter of Concern	Willamette River	Johnson Creek	Kellogg Creek
Temperature	X		
Fecal Coliform	X	X	

Parameter of Concern	Willamette River	Johnson Creek	Kellogg Creek
E Coli			X
Dieldrin	X	X	
PCB	X	X	
DDT	X	X	
Polynuclear Aromatic Hydrocarbons	X	X	
Biological Criteria	X		
Aldrin	X		
Manganese	X		
Iron	X		
Pentachlorophenol	X		
Mercury	X		

TMDLs have not yet been established for these waterbodies however, the Willamette and Johnson Creek TMDLs are imminent. A target date for the Kellogg Creek TMDL is currently unknown.

FISH PASSAGE

The primary drainages in Milwaukie are Kellogg Creek, which receives runoff from the southern portion of the City and flows generally northwest to the Willamette River; and Johnson Creek, which receives a small proportion of its flow from the northern part of the City and flows southwest to the Willamette River. Throughout the City are many small and unnamed tributaries to both of these streams, and to the Willamette River. It is likely that there are barriers to fish passage on many of the tributaries but the focus of the fish passage study was Spring Creek. (Note: Photos referenced in the following text are provided in Appendix G.)

Spring Creek is a lower Johnson Creek tributary which originates near Washington and SE 30th Streets from an underground spring, contained in a concrete-lined pond (Figure 4, Photo 1. The stream flows from the springs through an artificial pond (Photo 1), impounded by an 8-foot-tall earthen dam. The dam is equipped with a non-functioning waterwheel at the downstream face (Photo 2). It appears that concrete flumes and weirs were historically used to direct water to the wheel. The banks of the pond are concrete, and failing in some locations. The pond is located in a highly artificial maintained park-like setting with numerous concrete channels, diverting or otherwise controlling the stream flow. The visible substrate is entirely silt and organic sediment; the water appears clear.

Immediately downstream of the dam described above, the stream enters a submerged culvert under Washington St. Downstream of Washington St., the stream enters a second linear shaped pond, controlled by a weir at the culvert under Monroe St. (Figure 4). The upstream end of the pond (at Washington St.) appears to have natural stream banks, but was likely excavated and reshaped during the period the other portions of Spring Creek were altered. Streamside vegetation is primarily Himalayan blackberry, with an overstory of mature conifers which provide significant shading.

The downstream portion of this pond (at Monroe St.) is in a maintained backyard natural area, and is well shaded by native and non-native trees and shrubs. Much like the other ponds along Spring Creek, the banks are concrete and the substrate is primarily silt. The stream continues through a culvert northwest under Monroe St., and into a third pond (Photo 3). This pond is impounded by a dam-and-weir structure near a residence adjacent to the stream. The pond appears more natural than the others in the system, and has a riparian area of dense shrubs and trees, many of which are non-native, but which provide adequate shading and cover.

Downstream, an inlet controlled culvert which runs under a parking lot and the Union Pacific Railroad line impounds the creek near SE 26th Avenue (Figure 4, Photo 4). The creek flows west across the Waldorf School campus in a wholly artificial concrete-lined channel, passing through several concrete ponds, culverts, and small falls (Photo 5). Riparian vegetation is non-existent on the campus, and where the stream is impounded, summer season algal growth indicates potentially degraded water quality. Exiting the campus, the creek passes over an eight-foot ornamental waterfall and into a 30- by 20-foot concrete pond, then flows underneath SE Harrison St. (Photo 6). This culvert, which carries flow under both Harrison St. and a residence, is backwatered by another artificial pond in Scott Park (Photos 7, 8).

In Scott Park, the stream is ponded in a park-like setting that consists of lawn grass, and an overstory of scattered ornamental trees and shrubs (Photos 7, 8). The pond is bounded by residential properties and parking lots. Urban waterfowl, such as resident Canada geese, and mallard ducks appear abundant, potentially contributing to elevated nutrient and bacteria levels in the pond. The northern bank of the downstream most section of the pond consists of a retaining wall alongside a restaurant parking lot, and lacks vegetation of any kind (Photo 8). The southern bank of the pond consists of a remnant 3 to 4 foot-tall concrete embankment and a lawn area. This bank is actively eroding, and is vegetated with one mature ornamental tree and lawn grass (Photo 8). From Scott Park the creek flows over a weir (Photo 9) and into an approximately 300 foot-long pipe and into a drop manhole near Hwy 99E (Figure 4). From this manhole, the creek, along with other surface water collected at this manhole, flows west under Hwy 99E in a 48 inch corrugated metal pipe (CMP) to its confluence with Johnson Creek (Photo 10).The outlet of the culvert is submerged at winter base flow, and roughly half of it's diameter is embedded in natural substrate. In total, the creek is less than 0.5 miles from its headwater springs to the confluence with Johnson Creek.

SECTION 3 – STUDY METHODS AND RESULTS

3.1 FLOOD CONTROL EVALUATION AND RESULTS

To evaluate the capacity of the existing piped stormwater system to adequately convey storm water runoff, a computer model was developed to simulate the hydrologic/hydraulic conditions of the public storm drainage system. The storm system was evaluated under future land use conditions because the City of Milwaukie is so close to build out conditions. The XP-SWMM model was selected to conduct these analyses. The XP-SWMM model is a proprietary version of the SWMM (stormwater management model) program, which was developed by the Environmental Protection Agency for the hydrologic, hydraulic and water quality analyses of combined sewer or separate sewer systems in urban environments. The portion of the software that is used to conduct the hydrologic analyses is called the RUNOFF block and the portion of the software that is used to conduct the hydraulic analyses is called the EXTRAN block. In order to develop the hydrologic and hydraulic computer model of the existing stormwater system, a number of input parameters were needed to develop the RUNOFF and EXTRAN blocks of XP-SWMM. Many of these parameters were obtained from the City's Geographic Information System (GIS). The information in this section describes the required input parameters and specifies the methods used for obtaining the data. The necessary model input parameters are listed below in the following three categories:

- Meteorological Data (e.g., rainfall, design storms)
- Subbasin Hydrologic Data (e.g., areas, impervious percentages, infiltration parameters)
- Storm Drainage System Hydraulic Data (e.g., pipe sizes, pipe materials, pipe lengths and invert elevations)

3.1.1 Meteorological Data

Design Storms and Precipitation Data

Design storms are typically used to evaluate the capacity of storm drainage systems and design capital improvements for the desired level of flood protection. The City of Milwaukie elected to use the level of protection established in the previous Surface Water Master Plan (Montgomery Watson, 1997). The 1997 plan includes degrees of protection depending on the size of the drainage area, and type of system as follows:

- Storm sewer pipes draining less than 640 acres: 25-year, 24-hour design storm.
- Storm sewer pipes draining greater than 640 acres: 50-year, 24-hour design storm.
- Open channels draining less than 250 acres: 25-year, 24-hour design storm.
- Open channels draining greater than 250 acres: 50-year, 24-hour design storm.
- Open channels draining greater than 640 acres: 100-year, 24-hour design storm.

For this study, the 10-, 25-, 50-, and 100-year, 24-hour design storm volumes that were used in the stormwater system evaluation were obtained from isopluvial maps published by the National Oceanographic and Atmospheric Administration (NOAA). These design storm volumes are consistent with the volumes used in the 1997 plan. The 24-hour storm volumes for each of the storm events are shown in Table 3-1.

Table 3-1 24-Hour Design Storm Volumes

Design Event	Depth (in)
10 yr	3.5
25 yr	4.0
50 yr	4.4
100 yr	4.7

The design storms were assumed to follow the SCS Type IA distribution. The SCS Type IA distribution was developed for Western Oregon, Washington, and Northwestern California.

Rainfall data from a specific historic event was also obtained for use in calibrating the model. The data were obtained from the City of Portland Harney Raingage from an event that occurred in January 31, 2003.

3.1.2 Subbasin Hydrologic Data

The City of Milwaukie study area was subdivided into smaller subbasins for modeling purposes. The subbasin boundaries were delineated based on the topographic map and the locations of the existing drainage system. The subbasin boundaries were then digitized into the GIS. Many of the subbasin hydrologic data were developed through the use of GIS. In order for the RUNOFF block of XP-SWMM to generate a stormwater runoff hydrograph for each subbasin, the following parameters were specified for each subbasin:

- Subbasin name or number.
- Area of subbasin (acres).
- Hydraulically connected impervious percentage (percent).
- Average ground slope (dimensionless, ft/ft).
- Pervious area curve number (CN).
- Time of concentration (minutes).

The methods that were used to generate the values of these parameters for use in the XP-SWMM model are described below.

<u>Subbasin Name</u>
The subbasin name was assigned using a two-letter abbreviation for the major basin (e.g., JC for Johnson Creek). Basin names and codes are shown in Table 3-2. A third letter was used to identify each significant drainage system within the major basin. Following the

two or three letter characters, numbers starting with 10 and increasing in increments of 10 were assigned to each subbasin. The manhole IDs were obtained from the City's GIS.

Table 3-2 Assigned Basin Names and Codes

Basin Name	Basin Code
Johnson Creek	JC
Willamette River	WR
Lower Kellogg Creek	KC
Spring Creek	SC
Milwaukie Drywell	MD
Middle Mt. Scott	MS

Subbasin Areas
The GIS was used to calculate areas within the subbasin boundaries.

Subbasin Effective Impervious Percentages
Effective impervious percentage is the portion of the mapped impervious area within a subbasin that is directly connected to the drainage collection system. The amount of impervious area in a subbasin is typically characterized based on its land use. Mapped impervious area estimates were developed based on land use data obtained from the surface water master plan developed by Montgomery Watson (1997) in agreement with the City. Effective impervious area percentages were assigned to each land use type as shown in Table 3-3. An area weighted effective impervious percentage was then calculated for each subbasin:

Table 3-3 Impervious Area Percentage

Land Use	Land USE Code	Land Use Designation	Impervious %
Commercial	C	Commercial	75
	C/HD	Commercial High Density	80
Industrial	I	Industrial	65
Residential	HD	High Density	75
	MED. D	Medium and Moderate Density	55
	LD	Low Density	35
Public	P	Public	45
Town Center	TC	Town Center	65

Subbasin Slope (units = dimensionless, ft/ft)
The subbasin slope is the average slope along the pathway of overland flow to the inlet of the drainage system. The subbasin slope was developed based on the digital topographic data contained in the City's GIS.

Pervious Area Curve Number (units = dimensionless, CN)
The pervious area curve number is a dimensionless number that depends on hydrologic soil group, cover type, and antecedent moisture conditions. Runoff curve numbers for pervious areas were estimated from typical runoff curve number tables as shown in Table 3-4:

Table 3-4 Runoff Curve Numbers for Urban Areas

Land Use description	Average % Impervious	Curve Numbers for Hydrologic Soil Group			
		A	B	C	D
Fully developed urban areas (vegetation establish)					
Open space (lawns, parks, golf courses, cemeteries, etc)					
Good condition (grass cover >75%)		39	61	74	80
Fair condition (grass cover 50 to 75%)		49	69	79	84
Poor condition (grass cover <50%)		68	79	86	89
Paved parking lots, roofs, driveways, etc.		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excl. right-of-way)		98	98	98	98
Gravel (incl. Right-of-way)		76	85	89	91
Dirt (incl. Right-of-way)		72	82	87	89
Paved with open ditches (incl. Right-of-way)		83	89	92	93
Comercial and business areas	85	89	92	94	95
Industrial districts	72	81	88	91	93
Row houses, town houses, and residential with lot sizes 1/8 ac or less	65	77	85	90	92
Residential average lot size					
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acre	12	46	65	77	82
Developing urban areas (no vegetation established)					
Newly graded area		77	86	91	94

FHWA Urban Drainage Design Manual Hydraulic Engineering Circular No.22, November 1996

Time of Concentration (units = minutes)
The time of concentration is the time for runoff to travel from the most distant point of the watershed to the point in question. The time of concentration was computed by summing all the travel times for consecutive components of the drainage system (i.e., sheet flow, shallow concentrated flow, open channel flow, and pipe flow).

3.1.3 Storm Drainage System Hydraulic Data

The primary purpose of the modeling was to conduct a hydraulic analysis of the piped storm drainage system. The following parameters were required in the EXTRAN block of XP-SWMM for the open channels and culverts:

- Segment name.
- Upstream manhole number.
- Downstream manhole number.
- Length of segment (feet).
- Invert elevation at upstream manhole (feet).
- Ground surface elevation at upstream manhole (feet).
- Invert elevation at downstream manhole (feet).
- Ground elevation at downstream manhole (feet).
- Channel cross section.

Conduit Name or Number, Upstream Manhole Number, and Downstream Manhole Number

A conduit name was assigned to each modeled pipe and open channel using the subbasin names followed by a letter (i.e., JCA30b). Upstream and downstream manhole numbers were obtained from the City.

Conduit Shape

Pipe shapes were provided by the City. The geometry of all open channel segments was assumed to be trapezoidal. Cross-sections for Kellogg Creek were obtained from the 1997 master plan model.

Pipe Diameter

Pipe diameters for each pipe segment, in inches, were provided by the City.

Conduit Lengths

The length of most pipe segments was provided by the City. When the pipe length was not provided, lengths were scaled from GIS maps. Lengths for all open channels conduits were scaled from GIS maps.

Ground Surface Elevation at Upstream and Downstream Manholes

The ground surface elevation at each manhole location was necessary to accurately simulate possible surcharging of the sewer system. The elevation of the rim of each manhole was estimated from two-foot contour maps provided by the City.

Invert Elevations at Upstream and Downstream Manholes

The upstream and downstream invert elevations for each pipe segment were obtained using manhole depths provided by the City in association with ground surface elevations estimated from the two-foot contour maps as described above. Invert elevations for open channels were obtained from the City or assumed to be the same as the upstream or downstream pipe invert elevations.

Pipe Materials

In order to assign a Manning's roughness coefficient for each pipe segment, the pipe material was needed. The City provided information on pipe material and the roughness coefficient was then assigned by URS as follows:

Table 3-5 Assigned Manning's Roughness Coefficients

Material	Manning's n
Concrete Pipe	0.014
Corrugated Metal Pipe	0.024
Plastic	0.011
Open Channels	0.035

3.1.4 Flood Control Modeling Methods

As stated earlier, to evaluate flood hazard, the XP-SWMM computer model was used to simulate the hydrologic and hydraulic performance of the piped system. The hydrology routine in XP-SWMM converts rainfall into stormwater runoff based on the design storm parameters (e.g., volume and intensity of rainfall) and subbasin characteristics such as topography, land use, vegetation, and soil types. The hydraulics routine in the model then routes the stormwater runoff through the drainage system and enables predictions to be made of stormwater flow rates, water surface elevations, and velocities during design storms.

A schematic plot of the modeled system is shown in Figure 5. In general, the evaluation concentrated on the significant components of the public drainage system; typically, all storm pipes with a diameter of 15-inches or greater.

In order to develop the hydrologic and hydraulic computer models for the system, the study area was subdivided into 98 subbasins (Figure 5). The subbasin boundaries were digitized into the GIS so that the hydrologic data could be generated for each subbasin. Information for the piped system was obtained from the City's GIS, interpretation of as-built drawings of recent developments, and interviews with City staff and field checks.

Model analyses were not conducted for the areas served by drywells. Flooding issues in this area were identified based on City observations.

To check model results, City personnel provided information regarding past observed flooding problems during the January 31, 2003 storm event. During this event the City of Portland Harney rain gage measured 2.93 inches of rain with an hourly maximum intensity of 0.60 inches/hr. This January 2003 event was estimated by the City of Milwaukie to represent between the 2-year and 5-year storm. Based on the information provided by City staff, two observed flooding problems were identified in the study area. These observed flooding problems included street flooding associated with insufficient pipe capacity at SE Harrison St. and SE 23rd Ave. and at SE Railroad Ave. between SE 32nd and SE 34th Aves. When the model was run for this January 31, 2003 event, flooding problems were shown to occur in the same areas that city staff had observed them. However, the model appeared to be overestimating water surface elevations. Therefore, specific model parameters were adjusted by 80% to obtain a better representation of the observed conditions during the January 31, 2003 storm event. The model input parameters that were adjusted for this calibration included the impervious percentage areas and the curve numbers. These calibrations adjustments were then applied citywide.

3.1.5 Flood Control Results

Flooding problems were identified as those areas in the model results where flows were observed on road surfaces. In other words, surcharging was considered to be acceptable as long as flows did not come out into the roadways.

The XP-SWMM model input data and results are provided in Table 3-6 and illustrated on Figure 6. Table 3-6 includes peak flows and water surface elevations for the relevant design storms. The last two columns in the table indicate which conduits are expected to be deficient and when (i.e., design storm) and which capital improvement project is proposed to address the problem (see Section 4.0). Additional detailed information regarding the model results (e.g., results for all storms modeled) for hydrology and hydraulics are provided in Appendices A and B.

It should be noted that each pipe segment in the XP-SWMM model may include several individual pipe runs between manholes if pipe material and size were consistent and slope did not change drastically. One hundred and forty five pipe segments were modeled. Of these 145 segments, problems were predicted for 25 segments (see Figure 6). Nineteen of these 25 problems were predicted for the 10-year storm. It should be noted that capital improvement projects were all designed for the 25-year storm. In general, 10-year flooding problems were predicted for the following locations:

- A pipe segment located east of the intersection between SE. Milport Rd. and SE. Main St. (JCB10d)
- Pipe segments along SE. Monroe St. starting at the intersection between SE. Harrison St. and SE. Monroe St. extending southeast to 37th St. (JCA40b)
- Pipe segments along SE. Harrison St. starting at 23rd Ave. and extending east to the intersection between SE. Harrison St. and SE. Monroe St. (JCA30b, JCA40a, and JCA40b)
- A pipe segment along 21st Ave. starting at the intersection between SE. Harrison St. and 21st Ave. and extending south to SE. Monroe St. (JCA20)
- A pipe segments along Washington St. starting at the intersection between SE. Main St. and Adams St. and extending approximately one block southeast of Oak St. (KC10b, KC30a, and KC30b)
- A pipe segment along 18th Ave. between Wren St and Blue Bird St. (WRA30e)
- A pipe segment along SE. Lake Rd. between SE. 40th Ave. and SE. Freeman. (MSC40d)
- Pipe segments between SE. Stanley Ave. and SE. Linwood Ave. south of Kent St. (MSA80c, MSA80b, MSA80a, and MSA70d)
- A pipe segment along Railroad Ave. west of SE. Stanley Ave. (MSA20c)
- A pipe segment between Hemlock St. and Harmony St. east of Cedar Crest Dr. (MSA100f and MSA100e)
- A pipe segment along Harmony St. west of Cedar Crest Dr. (MSA100c)

Six problems were predicted for pipes for the 25-year storm at the following locations.

- A pipe segment northwest of Winsor Dr. (JDC80b)
- A pipe segment along 32nd Ave. (JCA50b)
- A pipe Segment along SE. Harrison St. between SE. Monroe St. and 32nd Ave. (JCA50a)
- A pipe segment along SE. Harrison St. between 21st Ave. and 23rd Ave. (JCA30a)
- A pipe segment along Railroad Ave. west of SE. Linwood Ave. (MSA30a)
- A pipe segment along harmony St. east of Cedar Crest Dr. (MSA100d)

For the area served by drywells, the City has observed capacity constraints along SE. King Rd.

TABLE 3-6 HYDRAULIC PERFORMANCE OF THE CITY OF MILWAUKIE STORM DRAINAGE SYSTEM

Structure ID	Node ID		Structure Size/Type	Structure Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm	Water Surface Elevation For Design Storm (ft) Existing Land Use		Frequency of Storm that Provides Deficiency (Year)	Number of CIP to Address The Problem
	Upstream	Downstream				Existing	Upstream	Downstream		
System #1										
JDC80b.1	31024	22673	15-in Dia	282	25	7.0	124.1	120.0	25	CIP-9
JDC80b-rd	31024	22673	Roadway	282		1.3	124.1	122.1		
JDC80a.1	22673	33039	18-in Dia	786	25	8.3	120.0	111.7		
JDC80a-rd	22673	33039	Roadway	786		0.0	111.7	111.7		
JDC70d.1	31019	31018	18-in Dia	177	25	5.2	153.8	153.1		
JDC70d-rd	31019	31018	Roadway	177		0.0	153.1	153.1		
JDC70c	31018	33033	18-in Dia	242	25	5.2	153.1	152.3		
JDC70b	33033	33039	24-in Dia	924	25	5.2	151.5	111.7		
JDC70a.1	33039	33040	24-in Dia	370	25	10.8	111.7	110.6		
JDC70a-rd	33039	33040	Roadway	370		0.0	110.2	110.2		
JCD50c	33040	33043	24-in Dia	494	25	10.8	110.2	107.1		
JCD50b	33043	33023	36-in Dia	476	25	10.8	107.1	105.4		
JDC60	33031	33025	36-in Dia	908	25	2.8	145.2	143.7		
JCD50e	33025	33024	24-in Dia	263	25	2.8	143.7	105.5		
JCD50d	33024	33023	36-in Dia	51	25	2.8	105.5	105.4		
JCD50a	33023	25262	48-in Dia	663	25	16.9	105.4	105.1		
System #2										
JCD20	21290	21516	18-in Dia	413	25	0.9	143.2	140.6		
JCD30b	21516	21515	21-in Dia	253	25	0.9	140.6	138.1		
JCD30a	21515	21520	24-in Dia	726	25	3.5	138.1	119.8		
JCD40b	21501	21504	18-in Dia	398	25	5.5	140.1	122.9		
JCD40a	21504	21520	24-in Dia	31	25	4.1	122.9	119.8		
JCD10c.1	21520	21526	24-in Dia	967	25	8.9	119.8	101.8		
JCD10c-rd	21520	21526	Roadway	967		0.0	101.8	101.8		
JCD10a	21526	25270	15-in Dia	276	25	6.0	101.8	98.7		
JCD10b	21526	25271	24-in Dia	24	25	-6.4	101.8	101.7		
System #3										
JCC60c	21035	21043	18-in Dia	46	25	-3.2	142.9	142.7		
JCC60b	21043	21025	24-in Dia	1402	25	3.2	142.7	134.3		
JCC60a	21025	21013	30-in Dia	243	25	3.2	134.3	133.9		
JCC70	21021	21023	15-in Dia	206	25	2.7	147.8	145.0		
JCC80	21024	21023	15-in Dia	257	25	0.7	145.8	145.0		
JCC60e	21023	21022	15-in Dia	104	25	3.4	145.0	144.1		
JCC60d	21022	21013	18-in Dia	676	25	3.4	144.1	133.9		
JCC50c	21013	21005	36-in Dia	337	25	6.5	133.9	132.4		
JCC50b	21002	21003	15-in Dia	257	25	3.6	140.3	138.5		
JCC50a	21003	21005	15-in Dia	415	25	3.6	138.5	132.4		
JCC40	21005	21037	36-in Dia	699	25	10.0	132.4	108.4		
JCC30	21039	21037	20-in Dia	698	25	4.8	120.1	108.4		
JCC20c	21037	23003	36-in Dia	745	25	15.2	108.4	59.7		

Structure ID	Node ID		Structure Size/Type	Structure Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm	Water Surface Elevation For Design Storm (ft)		Frequency of Storm that Provides Deficiency (Year)	Number of CIP to Address The Problem
							Existing Land Use			
	Upstream	Downstream				Existing	Upstream	Downstream		
JCC110b	22102	21143	18-in Dia	672	25	2.5	147.0	139.8		
JCC110a	21143	21135	24-in Dia	325	25	2.5	139.8	138.6		
JCC120.1	31003	21353	15-in Dia	467	25	5.4	152.7	147.3		
JCC120-rd	31003	21353	Roadway	467		0.0	147.3	147.3		
JCC100b	21353	21135	24-in Dia	1867	25	5.4	147.3	138.6		
JCC100a.1	21135	21015	30-in Dia	651	25	7.9	138.6	127.2		
JCC100a-rd	21135	21015	Roadway	651		0.0	127.2	127.2		
JCC90b.1	21015	25019	24-in Dia	1404	25	12.5	127.2	67.8		
JCC90b-rd	21015	25019	Roadway	1404		0.0	67.8	67.8		
JCC90a	25019	23003	Natural	409	25/NA	19.9	67.8	59.7		
JCC20b	23003	Roswell	48-in Dia	279	25	34.5	59.7	57.7		
Roswell Outlet										
JCC20a	25245	21267	30-in Dia	55	25	20.3	53.8	51.7		
JCC10b.1	21267	301	42-in Dia	1324	25	22.7	51.7	47.3		
JCC10b-rd	21267	301	Roadway	1324		0.0	47.3	47.3		
JCC10a	301	25237	48-in Dia	242	25	27.0	47.3	47.2		
System #4										
JCB10d.1	21265	21059	12x24-in Dia	307	25	7.5	41.3	39.3	10	CIP-15
JCB10d-rd	21265	21059	Roadway	307		-16.7	41.3	41.3		
JCB10c	21059	400	24-in Dia	73	25	21.4	39.3	35.8		
JCB30b.1	22413	405	18-in Dia	410	25	7.6	44.7	41.2		
JCB30b-rd	22413	405	Roadway	410		0.0	41.2	41.2		
JCB30a	405	403	24-in Dia	160	25	7.6	41.2	40.0		
JCB20c	21066	21065	18-in Dia	402	25	6.5	46.0	42.5		
JCB20b	21065	21064	21-in Dia	318	25	6.5	42.5	40.7		
JCB20a	21064	403	18-in Dia	69	25	6.5	40.7	40.0		
JCB10f	403	404	30-in Dia	140	25	13.2	40.0	39.2		
JCB10e	404	400	36-in Dia	556	25	13.2	38.8	35.8		
JCB10b	400	26009	42-in Dia	161	25	33.9	35.8	34.6		
JCB10a	26009	25226	36-in Dia	425	25	33.9	34.6	33.3		
System #5										
JCA50b.1	21148	21169	15-in Dia	1892	25	11.5	144.1	102.1	25	CIP-2
JCA50b-rd	21148	21169	Roadway	1892		4.5	144.1	102.1		
JCA50a.1	21169	21171	18-in Dia	234	25	11.5	102.1	98.6	25	CIP-2
JCA50a-rd	21169	21171	Roadway	285		3.7	102.1	98.6		
JCA60.1	21187	21186	18-in Dia	738	25	11.8	163.7	121.2		
JCA60-rd	21187	21186	Roadway	738		0.0	121.2	121.2		
JCA40c	21186	21185	18-in Dia	148	25	11.8	121.2	116.1		
JCA40b.1	21185	21340	12-in Dia	577	25	5.6	116.1	100.2	10	CIP-2
JCA40b-rd	21185	21340	Roadway	577		6.2	116.1	100.2		
JCA40a.1	21340	21171	15-in Dia	1041	25	4.8	100.2	98.6	10	CIP-2
JCA40a-rd	21340	21171	Roadway	1041		6.2	100.2	98.6		
JCA30b.1	21171	21239	18-in Dia	2264	25	16.0	98.6	41.2	10	CIP-2
JCA30b-rd	21171	21239	Roadway	2209		13.3	98.6	41.2		

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	Upstream	Downstream				Existing	Upstream	Downstream		
JCA30a.1	21239	21364	24-in Dia	440	25	15.5	41.2	41.2	25	CIP-2
JCA30a-rd	21239	21364	Roadway	458		-20.3	41.2	41.2		
JCA20.1	21094	21364	15-in Dia	785	25	4.1	42.1	41.2	10	CIP-10
JCA20-rd	21094	21364	Roadway	780		3.8	42.1	41.2		
JCA10	21364	25213	24-in Dia	696	25	22.1	41.2	33.3		
System #6										
KC60.1	41069	41064	18-in Dia	791	25	6.2	100.1	98.7		
KC60-rd	41069	41064	Roadway	791		0.0	100.1	100.1		
KC50b.1	41065	41064	18-in Dia	420	25	3.0	98.7	98.7		
KC50b-rd	41065	41064	Roadway	420		0.0	98.7	98.7		
KC50a	41064	41031	24-in Dia	319	25	6.4	98.7	98.5		
KC40b.1	41032	41031	18-in Dia	384	25	-7.7	98.5	98.5		
KC40b-rd	41032	41031	Roadway	384		0.0	98.5	98.5		
KC40a	41031	41029	24-in Dia	234	25	7.2	98.5	98.3		
KC30b.1	41029	41109	18-in Dia	164	25	6.7	98.3	98.2	10	CIP-8
KC30b-rd	41029	41109	Roadway	164		4.5	98.3	98.2		
KC30a.1	41109	21101	18-in Dia	1029	25	11.0	98.2	92.3	10	CIP-8
KC30a-rd	41109	21101	Roadway	1029		10.0	98.2	92.3		
KC10b.1	21101	41005	18-in Dia	2119	25	15.5	92.3	45.8	10	CIP-8
KC10b-rd	21101	41005	Roadway	2119		15.9	92.3	45.8		
KC10a	41005	41006	21-in Dia	239	25	25.5	45.8	38.7		
KC20c.1	41020	41006	15-in Dia	1791	25	9.0	72.1	35.1	10	CIP-8
KC20c-rd	41020	41006	Roadway	1791		7.2	72.1	44.1		
KC20a	41006	45017	21-in Dia	64	25	41.4	35.1	27.2		
System #7										
WRA30e.1	11003	15009	18-in Dia	883	25	7.7	60.2	50.9	10	CIP-14
WRA30e-rd	11003	15009	Roadway	883		7.5	60.2	56.2		
WRA30d	15009	12055	Natural	70		15.2	50.9	43.6		
WRA30c	12055	15000	18-in Dia	287	25	14.3	43.6	38.2		
WRA30b	15000	104	Natural	677		14.4	38.2	28.2		
WRA30a	104	15005	36-in Dia	169	25	14.4	28.2	27.2		
System #8										
MSC10b.1	42292	41033	18-in Dia	462	25	7.2	92.9	80.3		
MSC10b-rd	42292	41033	Roadway	462		0.0	80.3	80.3		
MSC10a	41033	45009	24-in Dia	678	25	7.2	80.3	32.5		
System #9										
MSC40d.1	41091	42097	15-in Dia	1139	25	5.5	128.6	115.1	10	CIP-7
MSC40d-rd	41091	42097	Roadway	1139		2.9	128.6	120.6		
MSC40c	42097	41042	18-in Dia	1100	25	8.4	115.1	85.2		
MSC40b	41042	41043	18-in Dia	93	25	7.9	85.2	84.5		
MSC40a	41043	41044	18-in Dia	264	25	7.9	84.5	81.2		
MSC30	41045	41044	18-in Dia	148	25	-1.0	81.3	81.2		

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	Upstream	Downstream				Existing	Upstream	Downstream		
MSC20c	41044	41048	30-in Dia	447	25	8.8	81.2	73.6		
MSC60b	41055	41054	18-in Dia	103	25	5.3	80.0	79.8		
MSC60a	41054	41053	18-in Dia	121	25	-5.3	79.8	78.6		
MSC50c	41079	41076	15-in Dia	1210	25	1.8	80.2	78.7		
MSC50b	41076	41075	18-in Dia	90	25	-1.8	78.7	78.6		
MSC50a	41075	41053	24-in Dia	119	25	-1.8	78.6	78.6		
MSC20b	41053	41048	24-in Dia	229	25	6.6	78.6	73.6		
MSC20a	41048	45010	30-in Dia	1300	25	17.9	73.6	35.9		
System #10										
MSC80	41063	43000	21-in Dia	652	25	4.1	87.4	81.6		
MSC70b	43000	41074	21-in Dia	231	25	6.7	81.6	79.8		
MSC70a	41074	45013	21-in Dia	429	25	6.7	79.8	55.5		
System #11										
MSC110b	41099	41100	15-in Dia	619	25	3.0	97.4	86.6		
MSC110a	41100	41101	17-in Dia	47	25	3.0	86.6	86.3		
MSC100	42201	41101	15-in Dia	483	25	1.7	95.2	86.3		
MSC90b	41101	41103	21-in Dia	461	25	10.1	86.3	80.7		
MSC90a	41103	45014	24-in Dia	711	25	10.1	80.7	76.1		
System #12										
MSB20e.1	61105	61010	24-in Dia	889	25	18.5	90.0	83.2		
MSB20e-rd	61105	61010	Roadway	889		0.4	90.0	86.0		
MSB20d	61010	61028	24-in Dia	79	25	-18.8	83.2	82.2		
MSB20c	61028	61032	48-in Dia	1135	25	18.8	82.2	80.0		
MSB20b	61032	65029	54-in Dia	358	25	18.9	80.0	78.6		
MSB20a	65029	65032	Natural	42	25/NA	18.8	78.6	78.5		
MSB30c.1	66003	61027	48-in Dia	2226	25	20.1	84.2	81.4		
MSB30c-rd	66003	61027	Roadway	2226		0.0	81.4	81.4		
MSB30b.1	61027	61034	48-in Dia	1184	25	19.2	81.4	79.5		
MSB30b-rd	61027	61034	Roadway	1184		0.0	79.5	79.5		
MSB30a	61034	65032	48-in Dia	382	25	19.2	79.5	78.5		
MSB10c	65032	65031	Natural	119	25/NA	36.9	78.5	78.4		
MSC120c.1	61038	62355	15-in Dia	162	25	4.8	100.0	95.1		
MSC120c-rd	61038	62355	Roadway	162		0.1	100.0	98.0		
MSC120b	62355	61037	18-in Dia	124	25	6.1	95.1	85.0		
MSC120a	61037	65031	24-in Dia	146	25	-5.0	85.0	84.3		
MSB10b	65031	66007	Natural	777	25/NA	40.1	78.4	78.2		
MSB10a	66007	65027	48-in Dia	3076	25	65.6	78.2	66.1		
System #13										
MSA90.1	61160	61177	24-in Dia	2523	25	15.3	172.4	153.6		
MSA90-rd	61160	61177	Roadway	2523		0.0	153.6	153.6		
MSA80d	61159	61177	18-in Dia	583	25	5.9	175.1	153.6		
MSA80c.1	61177	61148	24-in Dia	253	25	-12.5	153.6	152.6	10	CIP-13

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	Upstream	Downstream				Existing	Upstream	Downstream		
MSA80c-rd	61177	61148	Roadway	253		6.1	153.6	152.6		
MSA80b.1	61148	61179	15-in Dia	243	25	5.3	152.6	152.5	10	CIP-13
MSA80b-rd	61148	61179	Roadway	243		17.2	152.6	152.5		
MSA80A	61179	61151	18-in Dia	186	25	6.1	152.5	152.3	10	CIP-13
MSA80A-rd	61179	61151	Roadway	186		15.0	152.5	152.3		
MSA70d.1	61151	65028	18-in Dia	684	25	9.3	152.3	143.7	10	CIP-13
MSA70d-rd	61151	65028	Roadway	684		16.2	152.3	149.3		
MSA70c	65028	66010	Natural	1111	25/NA	25.5	143.7	107.1		
MSA70b	66010	65034	30-in Dia	55	25	25.5	107.1	105.1		
MSA70a	65034	66009	Natural	174	25/NA	25.5	105.1	104.0		
MSA20c.1	62296	65011	15-in Dia	56	25	2.6	104.4	104.0	10	CIP-3
MSA20C-rd	62296	65011	Roadway	56		-10.1	104.4	104.3		
MSA20b	65011	66009	Natural	29	25/NA	12.6	104.0	104.0		
MSA20a	66009	65033	18-in Dia	59	25	8.0	104.0	102.6		
MSA10	61052	65023	24-in Dia	2075	25	4.0	152.9	102.8		
System #14										
MSA50b.1	62175	62179	18-in Dia	329	25	8.5	89.4	82.9		
MSA50b-rd	62175	62179	Roadway	329		0.0	82.9	82.9		
MSA60b	62318	62323	15-in Dia	301	25	1.9	143.8	131.4		
MSA60a	62323	62325	18-in Dia	323	25	1.9	130.0	109.6		
MSA50c.1	62325	62179	18-in Dia	397	25	2.6	108.8	82.9		
MSA50c-rd	62325	62179	Roadway	397		0.0	82.9	82.9		
MSA50a.1	62179	61107	18-in Dia	59	25	11.0	82.9	82.4		
MSA50a-rd	62179	61107	Roadway	59		0.0	82.4	82.4		
MSA30c	62290	62284	15-in Dia	490	25	4.6	90.4	82.4		
MSA30b.1	62284	62282	18-in Dia	47	25	4.6	82.4	82.4		
MSA30b-rd	62284	62282	Roadway	47		0.0	82.4	82.4		
MSA30a.1	62282	61107	20-in Dia	195	25	4.6	82.4	82.4	25	CIP-5
MSA30a-rd	62282	61107	Roadway	195		-1.1	82.4	82.4		
MSA40	61107	65015	24-in Dia	63	25	54.5	82.4	76.6		
System #15										
MSA100f.1	61115	61118	15-in Dia	234	25	10.9	123.0	122.3	10	CIP-11
MSA100f-rd	61115	61118	Roadway	234		24.6	123.0	122.6		
MSA100e.1	61118	62166	15-in Dia	287	25	14.6	122.3	107.1	10	CIP-11
MSA100e-rd	61118	62166	Roadway	287		14.1	122.3	107.1		
MSA100d.1	62166	62171	18-in Dia	271	25	23.3	107.1	96.1	25	CIP-11
MSA100d-rd	62166	62171	Roadway	271		4.5	107.1	96.1		
MSA100c.1	62171	62175	18-in Dia	188	25	15.4	96.1	89.4	10	CIP-11
MSA100c-rd	62171	62175	Roadway	188		12.8	96.1	92.1		
MSA100b.1	62175	62174	18-in Dia	38	25	21.2	89.4	84.6		
MSA100b-rd	62175	62174	Roadway	38		0.0	89.4	89.4		
MSA100a	62174	65016	24-in Dia	87	25	21.2	84.6	83.6		

3.2 WATER QUALITY EVALUATION AND RESULTS

For the piped stormwater system in the Milwaukie study area, the water quality evaluation was not based on developing a water quality model or evaluating water quality data, but rather on identifying potential opportunities for implementing water quality facilities in conjunction with proposed flood control facilities. While some land use types are known to produce somewhat higher concentrations of selected pollutants in runoff than other land use types, it is well known that runoff from all urban land use types is having significant adverse impacts on receiving waters. Therefore, water quality treatment facilities at any of the flood control projects would benefit receiving water quality. The focus of this evaluation was identifying some cost-effective and feasible options for controls while considering the location of these options with respect to potential upcoming TMDLs. Aerial photographs were reviewed for each of the proposed flood control management alternatives in terms of whether space was available in the adjacent areas for construction a surface water quality facility such as a detention pond, constructed wetland or swale.

For the drywell systems, a report was being prepared for the City (by HDR) in parallel with this report in order to evaluate the effects of stormwater injection on groundwater quality. This evaluation of the City's drywells was required to be conducted under the Underground Injection Control requirements. As a result of the study, 15 drywells were identified for decommissioning based on their proximity to drinking water wells. Therefore, rather than evaluate the water quality impacts of the drywells any further, this study looked at alternatives for managing runoff from the drywell catchment areas once the drywells are decommissioned.

3.3 FISH PASSAGE EVALUATION AND RESULTS

The Oregon Department of Fish and Wildlife StreamNet database was searched for records of anadromous fish use in Spring Creek, and interviews were conducted with ODFW staff regarding native resident fish use. Reference materials were also searched for previous watershed assessments for the Johnson Creek basin, and Johnson Creek Watershed Council staff were interviewed regarding general fish use and habitat value. Finally the available ODFW Fish Passage Program database of known fish passage barriers in Clackamas County was reviewed. The results of these evaluations were as follows:

<u>Fish Use and Habitat</u>
Very little information specific to Spring Creek was available from the cited sources. ODFW considers Spring Creek to be non-fish bearing, and unable to support runs of listed (or non-listed) anadromous fish, but has not conducted habitat or fish passage barrier surveys. Nearly the entire Spring Creek system has been altered in one manner or another. As described, dams have been built to impound the stream in a series of artificial ponds, and the channel has been redirected and concrete-lined in several locations. This type of manipulation was not uncommon in the early 20th century for recreational use and aesthetics. These modifications appear to have occurred in roughly

the same period, and concrete bank reinforcements, channel linings, and dams are deteriorating. Local residents reported that hatchery-raised rainbow trout had been stocked in the pond just upstream of Monroe St. in the 1970s and 1980s. Remnants of this non-native population are likely to be present throughout the system downstream, though ODFW has not conducted fish use surveys to confirm. Of note, a resident indicated that two of the sturgeon on exhibit at the Bonneville Hatchery were once kept in this pond, before being donated to the hatchery.

The ponded reach in Scott Park appears capable of supporting fish. However the slow moving and highly exposed nature of the waterbody would limit its use to non-native fish, such as bass and stickleback, which are adapted to warm, turbid slow-moving streams. The stream currently provides no habitat value in the reach through the Waldorf School, and the highly exposed nature of the stream reach on the campus may contribute to downstream water quality problems. Between the Waldorf School and Monroe St. (Figure 4), Spring Creek has a well vegetated riparian buffer and could provide forage and rearing habitat, but is impounded by a non-passable culvert under the Union Pacific Railroad (UPRR). This reach flows through the only segment of fairly natural stream channel in the basin; between the UPRR and a dam just downstream of Monroe St. Riparian conditions are relatively good upstream of Monroe St. as well, but the pond just below the headwater springs near Washington St. is entirely unvegetated. Large woody debris is generally absent from the system.

Fish Passage

Numerous passage barriers in the form of artificial falls, weirs, and culverts are present throughout the system (Table 3-7). Of the impounded locations described above, only the culverts under Monroe and Washington Streets are fish passable, though an impassable 8-foot dam is present immediately upstream of the Washington St. culvert.

Table 3-7 Potential Anadromous Fish Passage Impediments in the Spring Creek System; downstream to upstream

Feature	Location	Barrier	Rationale for passage determination
Hwy 99E – Scott Park pipe	Culvert and pipe system passing Spring Cr. from Scott Park under parking lots and Hwy 99E	Yes	Length, unknown configuration of drop manhole, screen in place at pond outlet (Photo 9). Pipe outlet at mouth submerged at winter base flow, may provide limited high flow refuge (Photo 10)
Harrison St. culvert	Culvert passing Spring Creek under residence and Harrison St.	No	Backwatered, unscreened
Ornamental falls at Waldorf School	NW corner of Waldorf School campus	Yes	8' falls (Photo 6)
Waldorf School campus	Concrete channel through campus	Partial	Insufficient low-flow depth, small falls impassable at low flow (Photo 5)
Culvert at Union Pacific Railroad	Culvert passing Spring Creek under railway and into concrete pond on Waldorf School campus	Yes	Vertical inflow, grate at inlet, (Photo 4)
Dam and weir downstream of Monroe St.	Adjacent to residence approximately 200' downstream of Monroe St.	Yes	6-8' dam and weir, no passage structure (Photo 4)

Feature	Location	Barrier	Rationale for passage determination
Monroe St. culvert	Culvert passing Spring Creek under Monroe St.	No	Backwatered, outlet submerged
Washington St. culvert	Culvert passing Spring Creek under Washington St.	No	Backwatered, outlet submerged
Dam and weir upstream of Washington St.	8-10' dam with water control weir immediately upstream of Washington St.	Yes	8-10' dam, no provision for fish passage (Photo 2)

The most notable barriers to fish passage are a 500-foot culvert under parking lots and Hwy 99E, an 8-foot ornamental waterfall at the downstream end of the Waldorf School reach, and two 8 to 10-foot in-line dams. The ODFW Fish Passage Program database did not survey the Spring Creek basin, and therefore does not identify passage barriers in the system (McDermott, et. al. 1998).

The pipe passing Spring Creek under Hwy 99E. trends generally northwest, but turns sharply at several locations. The pipe appears to receive some surface water runoff directly from inlets at parking lots and roadsides. The length of this culvert, combined with the direction change in the drop manhole constitute probable fish passage barriers. Recent research indicates that fish navigating through culverts of unknown lengths will not expend energy at their full potential, but will move ahead slowly to conserve energy (Behlke et. al 1989). Oregon Department of Fish and Wildlife recommends that culverts over 200 feet in length be equipped with 24-hour lighting systems to aid fish in navigating the culverts, and generally recognizes that culverts over 300 feet in length constitute impediments to fish passage (ODFW 1999). In addition to impeding fish movement, culverts in excess of 200 feet also require lower stream flow velocities than shorter culverts of the same size and slope. Older culverts were not typically designed for lower velocities, (approximately 2.0 feet/sec) that are needed to pass juvenile fish (WDFW 2003). Spring Creek converges with Johnson Creek at the outlet of a 48-inch pipe which runs from the drop manhole east of Hwy 99E westward to Johnson Creek. The outfall is wholly submerged during winter base flow, and is likely backwatered and passable to at least the manhole at summer low-flow (Photo 10). The outfall may provide a small amount of high flow refugia for out-migrating juvenile fish. The inlet of this pipe at Scott Park is blocked with a movable debris screen (Photo 9), which is in place at all times except when debris must be removed from the screen.

The falls on the Waldorf School campus appear to be constructed of grouted rock, and present a full barrier to fish passage at all flows (Photo 6). The smaller falls in the concrete channel (Photo 5) present a partial barrier to fish passage during low flow due to shallow laminar flow, and lack of plunge pools below. At higher flows, flow depth may be sufficient to allow migrating fish to jump the step-like falls.

The dams, weirs, and inlet controlled culverts which impound several artificial ponds in the system, present other barriers to fish passage. The culvert underneath the SPRR has a vertical drop inlet which blocks upstream egress from the culvert. The earthen dam approximately 200 feet upstream is 6 to 8 feet high and has no provision for fish passage. Finally, a second 8- to 10-foot high earthen dam blocks fish passage immediately upstream of Washington St., though only very degraded habitat is available in the artificial pond it impounds.

SECTION 4 – RECOMMENDED CAPITAL IMPROVEMENTS

This section describes the management alternatives (i.e., CIPs) that were selected to address problems identified in Section 3.0. Section 4.1 discusses flood control management alternatives, Section 4.2 discusses water quality management alternatives and Section 4.3 discusses fish passage alternatives on Spring Creek.

4.1 FLOOD CONTROL MANAGEMENT CIPs

As described in Section 3.0, flooding problems were identified when modeled flows went onto roadway surfaces. For each identified flooding problem, a conceptual capital improvement project was developed. In developing capital improvement projects (CIPs) to address flooding issues, the XP-SWMM model was used and the following design criteria were applied:

- Roughness coefficients (n values) for all new pipes were 0.011. This coefficient was selected based on the fact that the City uses High Density Polyethylene pipe (HDPE) for all new projects.
- All capital improvement projects were design for the 25-year design event.
- Pipe invert elevations were maintained in most cases and pipe sizes were increased. Re-grading of pipe systems was recommended only when necessary.

Only pipe replacements were considered as options for addressing capacity deficiencies in the stormwater system. Due to space limitations and permitting requirements alternative options such as detention ponds and drywells were not considered. Table 4-1 shows a list of pipes that need to be replaced in order for the system to meet the City's drainage standards. In the portion of the City that is served by drywells, the City's main focus was addressing UIC requirements that pertain to water quality (see Section 4.2). With respect to capacity, this area was not included in the XP-SWMM model. With one exception, the drywell system has been observed to be functioning well. For the area along King Rd. however, the City is interested in a pump station (CIP-6) to alleviate flows to drywells by routing these flows from subbasins MD120 to the new pipe system included in CIP-1 (see Table 4-1). With the exception of CIP-6, each potential capital improvement project listed below addresses one or more flooding problems identified in the model results. The locations of potential capital improvement projects are illustrated on Figure 7. Hydrologic/hydraulic model input parameters and model results associated with the modeling of proposed CIPs are provided in Appendices C and D. A capital improvement project fact sheet is also provided for each of the proposed capital improvement projects in Appendix E. The capital improvement project fact sheets provide a location map and more details regarding each project (e.g., estimated costs, drainage area, etc.). The unit costs that were used to develop capital improvement project cost estimates are provided in Appendix F.

Table 4-1 Proposed Pipe Improvements to Address Flooding Issues

Structure ID Where Problem is Expected	When Problem is Expected Based on Model Results	Capital Improvement Project ID	Flooding Been Observed or Projected
JCA50b JCA50a JCA40b JCA40a JCA30b JCA30a	25-Yr 25-Yr 10-Yr 10-Yr 10-Yr 25-Yr	**CIP-2** – Replace four pipe segments along 32nd Ave. starting south of Meek St. and extending to SE Monroe St. and Install new pipe along Meek St.	Observed
MSA20c	10-Yr	**CIP-3** – Pipe segments along SE. Stanley Ave. and Railroad Ave.	Projected
MSA61c	25-Yr	**CIP-4** – Install new pipe segment along Juniper and Apple St.	Observed
MSA30a	25-Yr	**CIP-5** – Replace pipe segment that outfalls to Mt Scott Creek.	Projected
N/A		**CIP-6** – Pump station at SE King Rd.	Observed
MSC40d	10-Yr	**CIP-7** – Replace pipe segment along SE. Lake Rd.	Projected
KC30b KC30a KC10b KC20c	10-Yr 10-Yr 10-Yr 10-Yr	**CIP-8** – Replace five pipe segments on Washington St. and SE. Lake Rd.	Projected
JDC80b	25-Yr	**CIP-9** – Northwest of Winsor Dr. pipe replacement.	Projected
JCA20	10-Yr	**CIP-10** – Replace pipe segment along 21st Ave. starting at the intersection between SE. Harrison St. and 21st Ave. and extending south to SE. Monroe St.	Projected
MSA100f MSA100e MSA100d MSA100c	10-Yr 10-Yr 25-Yr 10-Yr	**CIP-11** – Replace four pipe segments along Hemlock St. and Harmony Rd.	Projected
MSA80c MSA80b MSA80a MSA70d	10-Yr 10-Yr 10-Yr 10-Yr	**CIP-13** – Replace three pipe segments south of Furnberg St.	Projected
WRA30e	10-Yr	**CIP-14** – Replace pipe segment between Wren St. and Blue Bird St.	Projected
JCB10d	10-Yr	**CIP-15** –Replace one pipe segment east of the intersection between SE. Milport Rd. and SE. Main St.	Projected

4.2 WATER QUALITY MANAGEMENT CIPS

Identifying potential capital improvement projects to address water quality concerns is very different from identifying capital improvement projects to address flooding issues. With respect to flooding, specific capacity deficiencies are identified through modeling and capital improvement projects are proposed to address those deficiencies. With respect to water quality, pollutant discharges associated with urban runoff are present throughout the study area. Therefore, for this study, the focus of developing CIPs for water quality was on:

1) Identifying ways of obtaining water quality benefits associated with the identified flood control CIPs; and
2) Developing CIPs to handle flows from drywells requiring decommissioning as a result of the UIC rules designed to protect groundwater quality.

With respect to item 1 above, all of the flood control CIPs are pipe replacements in areas that are already built out. With the exception of two CIPs (discussed further below), space was not available for considering surface water quality facilities. However, underground structural facilities could be constructed at any of the pipe replacement CIPs. The goal would be to place these facilities as close to receiving water outfalls as possible in order to maximize treatment opportunities from the pipe systems. As two of the capital projects are located at outfalls, structural facilities for water quality were included in these CIPs. One is located at an outfall that discharges to Mount Scott Creek (CIP-5) and the other is located at an outfall that discharges to Kellogg Creek (CIP-8).

The two CIPs that did include space for surface water quality features included. CIP-2 (Meek St. area) and CIP-13 (South of Furnberg St.). For the Meek St. project, flows will be discharged into a detention facility that has already been constructed, and flows will be discharged to an open area for surface infiltration. As this project includes the rerouting of flows that are currently discharged into Johnson Creek (see CIP-2 fact sheet in Appendix E), it will provide a benefit to the Creek by reducing pollutant loads. For CIP-13, the project is routed directly through an open field. This would provide the potential to daylight the pipe and run the flows through a swale like treatment system prior to discharge through an outfall. The City has identified that this is a school field and that daylighting is not likely to be feasible. However, this issue will be considered during the design phase of the project.

As the TMDLs for Johnson Creek and the Willamette River are imminent, it's likely the City will need to develop additional CIPs to address water quality for these water bodies. Therefore an allowance was made in the CIP budget for additional but currently unidentified water quality CIPs. This allowance was based on constructing two additional structural facilities at outfall locations.

With respect to item 2 above, a report was developed by HDR (Evaluation of Stormwater Injection on Groundwater, 2004) to evaluate the City's drywells with respect to UIC requirements. As described in Section 3.2, 15 drywells were identified for decommissioning based on their proximity to domestic drinking water wells. Therefore, CIP-1 and CIP-3 were developed to handle flows associated with the decommissioning of these systems.

Table 4-2 below lists the CIPs that were developed (as described above) to address water quality objectives.

Table 4-2 Potential Water Quality Facilities

Potential Project ID	Capital Project Name	Capital Project Location	Drywells Decommissioned	Drainage Area Served, Acres
CIP-1	Brookside Storm Improvements	Manson Ln. to Rhodesa St.	34030, 34031, 34032, 34033, 34034, 34089, 34045, 34046, 34047, and 34147	125
CIP-2*	Meek St. and 32nd Ave. Pipe Improvements	Meek St. and 32nd Ave.		143.6
CIP-3*	SE. Stanley Ave. Pipe Replacement	SE. Stanley Ave. and Railroad Ave.	34135, 34137, and 34138	78.8
CIP-5	Outfall to Mount Scott Creek	The proposed Stormfilter (panel Vault w/112 Cartridges) will be located at the downstream end of the system that discharges to Mount Scott Creek.		42.3
CIP-8	Outfall to Kellogg Creek (Washington St and SE Lake Rd. Pipe Replacements)	The proposed Stormfilter (panel Vault w/112 Cartridges) will be located at the downstream end of the system that discharges to Kellogg Creek Lake.		130.9
CIP-12	Allowance for future WQ Facilities	Location will be evaluated in the future according to City's needs.		N/A

* CIP-2 and CIP-3 also addresses flood capacity deficiencies

4.3 FISH PASSAGE

Given the severe and frequent barriers to fish passage in the Spring Creek basin, only one passage barrier improvement was considered at this time: retrofit of the artificial falls on the Waldorf School campus. While the creek upstream of this barrier presents several other barriers, and provides poor habitat value within the school campus, reconstruction of the falls and naturalization and revegetation of the hardened stream channel could serve to provide a hands-on learning experience for students, and create a long-term nature study area. While this project would provide little benefit to listed anadromous fish in the City, a reestablished riparian buffer in the area may enhance water quality downstream, while increasing stewardship education. Therefore, the City will not include this project in the CIP list, but will consider it for community involvement when the opportunity or interest presents itself.

Replacement or retrofit of the pipe under Hwy 99E is not recommended at this time. The design, permitting, and construction costs and disruption that would be associated with replacement would be extremely high, particularly given the poor habitat value upstream. The culvert outlet appears passable for anadromous fish, and retrofit of the connecting pipe from Scott Park to the drop manhole and revision of the debris screen, may provide passage to the pond. However, as stated above, given the length of the pipes, daylighting all, or a portion of the pipe from the pond to the manhole may be necessary to provide passage. This work would involve a slightly smaller, but still significant investment in design, permitting, and construction, and would net very small gain to listed fish. Significant investment in habitat and passage barrier improvement upstream would be required to provide habitat of a quality to justify replacement or retrofit of the pipe.

Overall, the most effective improvements for anadromous and resident fish in the Spring Creek basin would be those associated with improving downstream water quality. These measures could include thorough riparian revegetation (particularly on the Waldorf School campus and in Scott Park), control of untreated surface water runoff to the stream, and control of waterfowl and human influence in the Scott Park area.

Given the high engineering and construction costs associated with fish passage improvement, and the fact that Spring Creek is not considered to be either fish bearing or important potential habitat, downstream water quality improvements would net higher benefits to fish in the Johnson Creek basin than providing passage where it does not currently exist. No structural fish passage improvements are recommended.

SECTION 5 - IMPLEMENTATION

As described in Section 4.0 a total of fifteen capital improvement projects were developed for consideration. Eight CIPs address observed and/or predicted flooding issues in the pipe system and water quality will be included in these CIPs during the design phase, two CIPs were developed to address drywell decommissioning requirements and also address observed flooding problems, two CIPs are located at outfalls and they address flooding issues and water quality issues through the use of underground structural treatment facilities, one CIP addresses flooding issues and it will address water quality through the use of a surface water facility, ones CIP addresses flooding issues and it has significant potential to address water quality through the use of a surface water quality facility (the feasibility of using the adjacent open space will be evaluated during the design phase), and one CIP provides funding to address water quality issues at two additional outfall locations based o anticipated future TMDL requirements for the Willamette River and Johnson Creek. Once the potential projects were identified, the next step was to rank the projects for implementation. There are several methods that are typically used for selecting and ranking capital improvement projects. Some include numerical scoring systems to rank the capital improvement projects based on specific characteristics such as drainage area served, cost, imminence of the problem, etc. These scoring methods can be simple or complicated. More complicated methods include weighting factors to prioritize the relative importance of each score. For example, depending on priorities, the score for imminence of the problem may be weighted more heavily than drainage area served. Other methods are more qualitative and based on the development of some guiding principles. The method selected can often depend on the number of potential capital improvement projects. For example, if the number of projects is very high, quantitative scoring methods may be the simplest to use.

For this Milwaukie Stormwater Master Plan, the number of projects that need to be evaluated is relatively small. Therefore, it made the most sense to rank projects on a qualitative basis.

5.1 RANKING OF CAPITAL IMPROVEMENT PROJECTS

The first step in the ranking of capital improvement projects was to prepare Table 5-1 summarizing some of the general characteristics of the projects.

Table 5-1 Information to Assist in Prioritizing Capital Improvement Projects

CIP ID	Capital Project Name	Drainage Area Served (acres)	Linear Footage of New Pipes and Replacements	Estimated Cost	Flooding Expected /Observed	Addresses UIC Require-ments***
CIP-1	Brookside Storm Improvements	125.0	4,652	$1,755,000	Observed	Yes

CIP ID	Capital Project Name	Drainage Area Served (acres)	Linear Footage of New Pipes and Replacements	Estimated Cost	Flooding Expected /Observed	Addresses UIC Require-ments***
CIP-2	Meek St. and 32nd Ave. Pipe Improvements	143.6	3,549	$1,856,900	Observed	
CIP-3	SE. Stanley Ave. Pipe Replacement	78.8	3,125	$1,079,000	Projected	Yes
CIP-4	Plum And Apple Storm Improvements	9.6	650	$131,100	Observed	
CIP-5	Outfall to Mt. Scott Creek	42.3	63	$345,900*	Projected	
CIP-6	SE. King Improvements	60.0	1,160	$273,900**	Observed	
CIP-7	SE. Lake Rd Pipe Replacement	27.7	1,139	$344,500	Projected	
CIP-8	Washington St. and SE. Lake Rd. Pipe Replacements	130.9	5,242	$2,563,700*	Projected	
CIP-9	Winsor Dr. Pipe Replacement	60.9	282	$61,900	Projected	
CIP-10	21st Ave. and SE. Monroe St. Pipe Replacement	19.0	785	$309,700	Projected	
CIP-11	Hemlock St. to Harmony Rd. Pipe Replacement	116.0	980	$397,200	Projected	
CIP-12	Allowance for Future Water Quality Facilities	TBD		$627,800		
CIP-13	Furnberg St. Pipe Replacement	87.2	1,113	$439,500	Projected	
CIP-14	18th Avenue Pipe Replacement	28.8	883	$365,400	Projected	
CIP-15	SE. Milport Rd. Pipe Replacement	35.2	307	$133,000	Projected	

* Cost includes underground water quality facility.
** Cost includes pump station elements
*** UIC locations were referenced from the HDR UIC Study (Evaluation of Stormwater Injection on Groundwater)

In discussions related to the ranking of capital improvement projects, three issues surfaced as guiding principles. These included the following: 1) capital improvement projects that address underground injection control requirements should be highly ranked; 2) flood control projects that address observed flooding problems should be highly ranked; and 3) projects where the benefits are relatively high when compared to cost should be highly ranked. Based on these guiding principals and the City's feedback, the proposed capital improvement projects were ranked in the following priority order based on the rationale that is provided.

1. **CIP-1: Brookside Storm Improvements**
   Rationale: This project was selected as highest priority due to the necessity to handle flows from ten drywells that are required to be decommissioned within 10 years.
2. **CIP-2: Meek St. and 32nd Ave. Pipe Improvements**
   Rationale: This project addresses observed flooding problems, and will eliminate the need for pipe replacements along Harrison St. This project is listed in the current City's CIP list.
3. **CIP-3: SE. Stanley Ave. Pipe Replacement**
   Rationale: This project addresses expected flooding problems caused by routing of additional flows from three drywells that are required to be decommissioned within 10 years.
4. **CIP-4: Plum and Apple Storm Improvements**
   Rationale: This project addresses observed flooding problems and is listed in the current City's CIP list.
5. **CIP-5: Outfall to Mt. Scott Creek**
   Rationale: This project addresses expected flooding problems, and it includes an underground water quality facility.
6. **CIP-6: SE. King Improvements**
   Rationale: This project will relieve capacity issues associated with several drywells that are under capacity along SE. King Rd. This project would be a continuation of the Brookside Storm Improvements Project (CIP-1).
7. **CIP-7: SE. Lake Rd. Pipe Replacement**
   Rationale: This project addresses observed flooding problems.
8. **CIP-8: Washington St. and SE. Lake Rd. Pipe Replacements**
   Rationale: This project addresses observed flooding problems, and it includes an underground water quality facility.
9. **CIP-9: Winsor Dr. Pipe Replacement**
   Rationale: This project will eliminate expected flooding problems.
10. **CIP-10: 21st Ave. and SE. Monroe St. Pipe Replacement**
    Rationale: This project will eliminate expected flooding problems.
11. **CIP-11: Hemlock St. to Harmony Rd. Pipe Replacements**
    Rationale: This project will eliminate expected flooding problems.
12. **CIP-12: Allowance for Future Water Quality Facilities**
    Rationale: This project will meet future needs that are anticipated as a result of imminent TMDL requirements.
13. **CIP-13: Furnberg St. Pipe Replacement**
    Rationale: This project will eliminate expected flooding problems. The significance of the flooding predicted was relatively low when compared to the other deficiencies identified.

14. **CIP-14: 18th Avenue Pipe Replacement**
    Rationale: This project was ranked as second to last due to the fact that maintenance staff experience with this system does not indicate that this would be a system of concern. Maintenance field staff will observe this system more closely over time to identify the need for this CIP. The significance of the flooding predicted was also relatively low when compared to the other deficiencies identified.
15. **CIP-15: SE. Milport Rd. Pipe Replacement**
    Rationale: This project was ranked last due to the fact that maintenance staff experience with this system does not indicate that this would be a system of concern. Maintenance field staff will observe this system more closely over time to identify the need for this CIP. The significance of the flooding predicted was relatively low when compared to the other deficiencies identified.

SECTION 6 - REFERENCES

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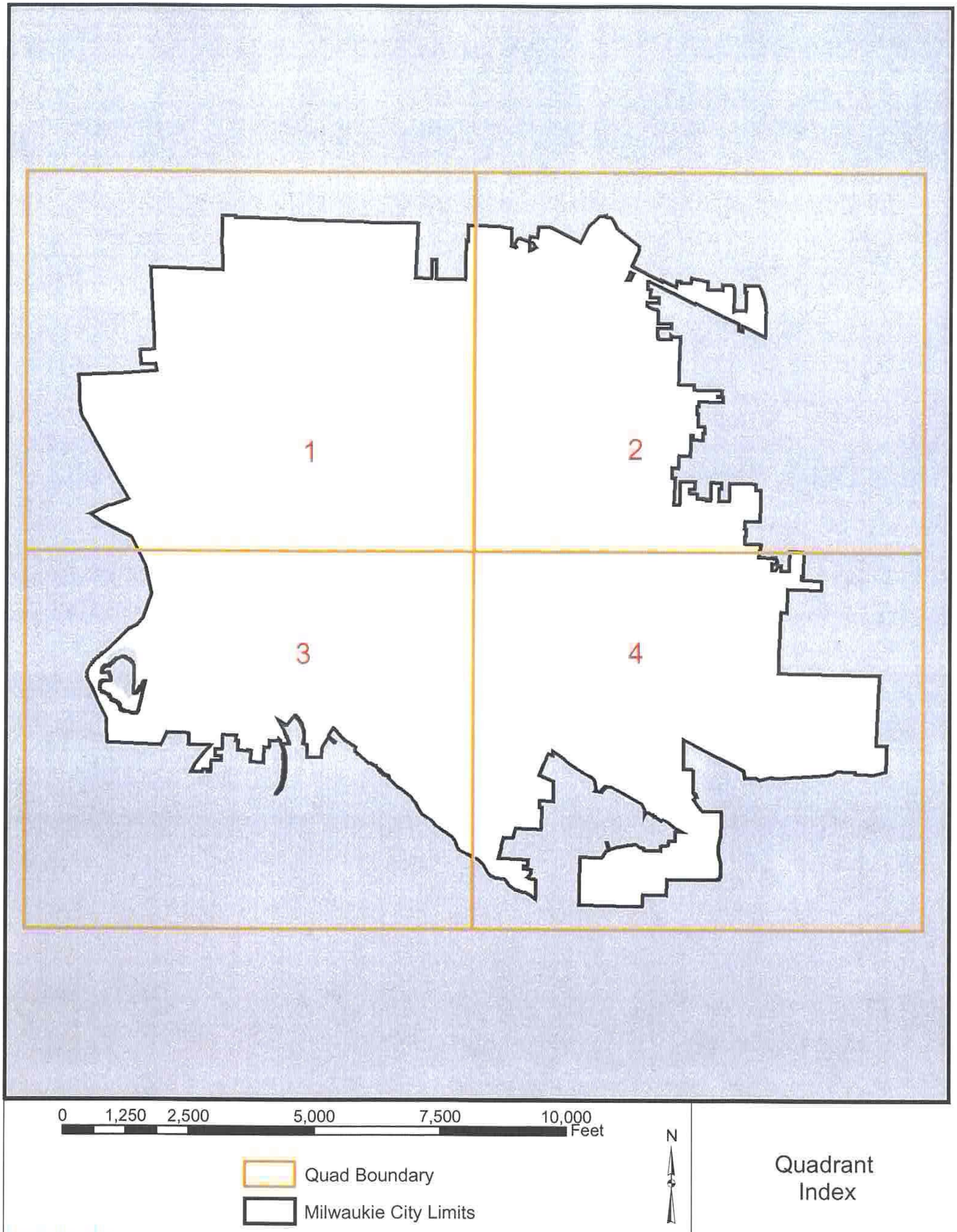
FIGURES



Quadrant Index

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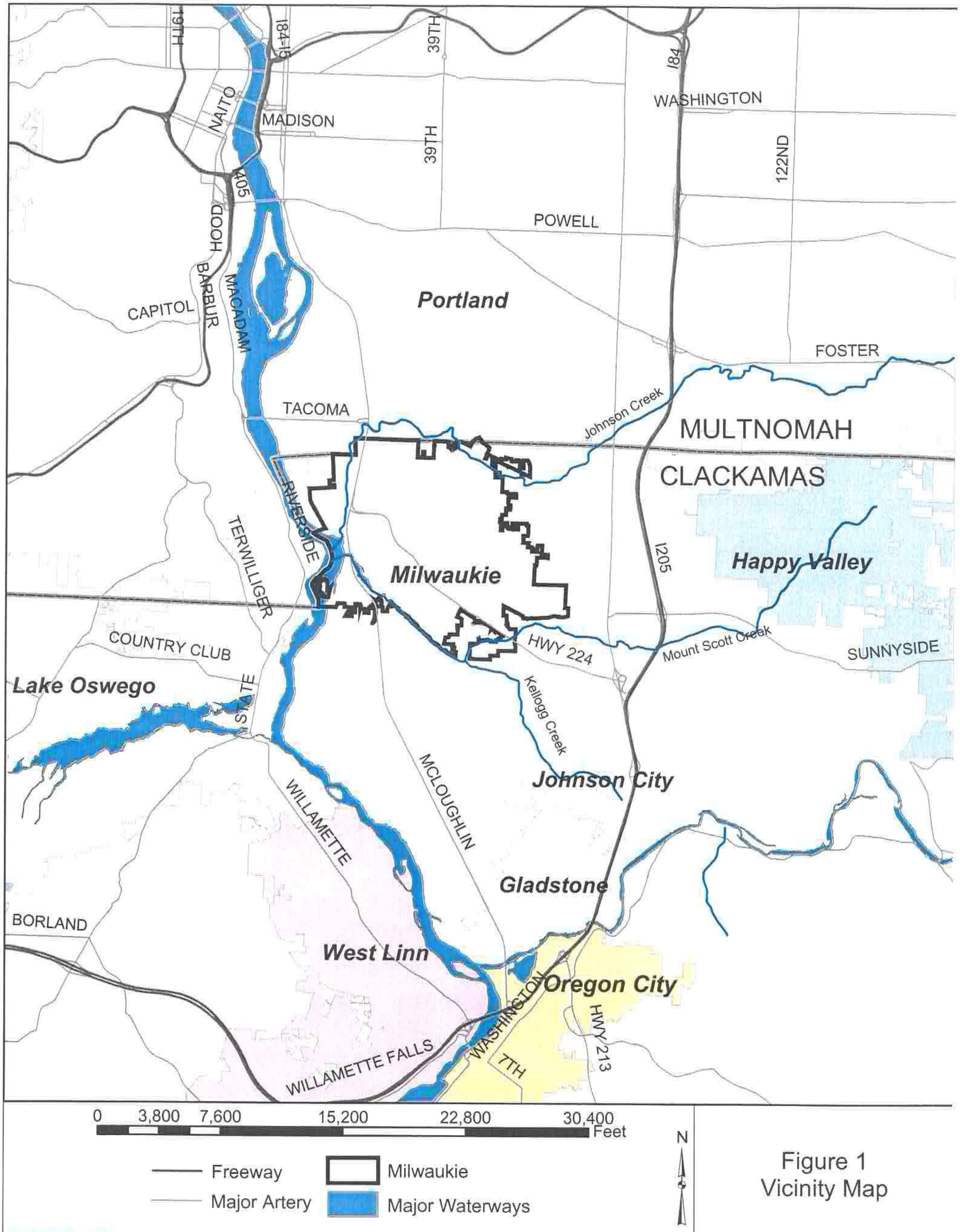

Figure 1
Vicinity Map

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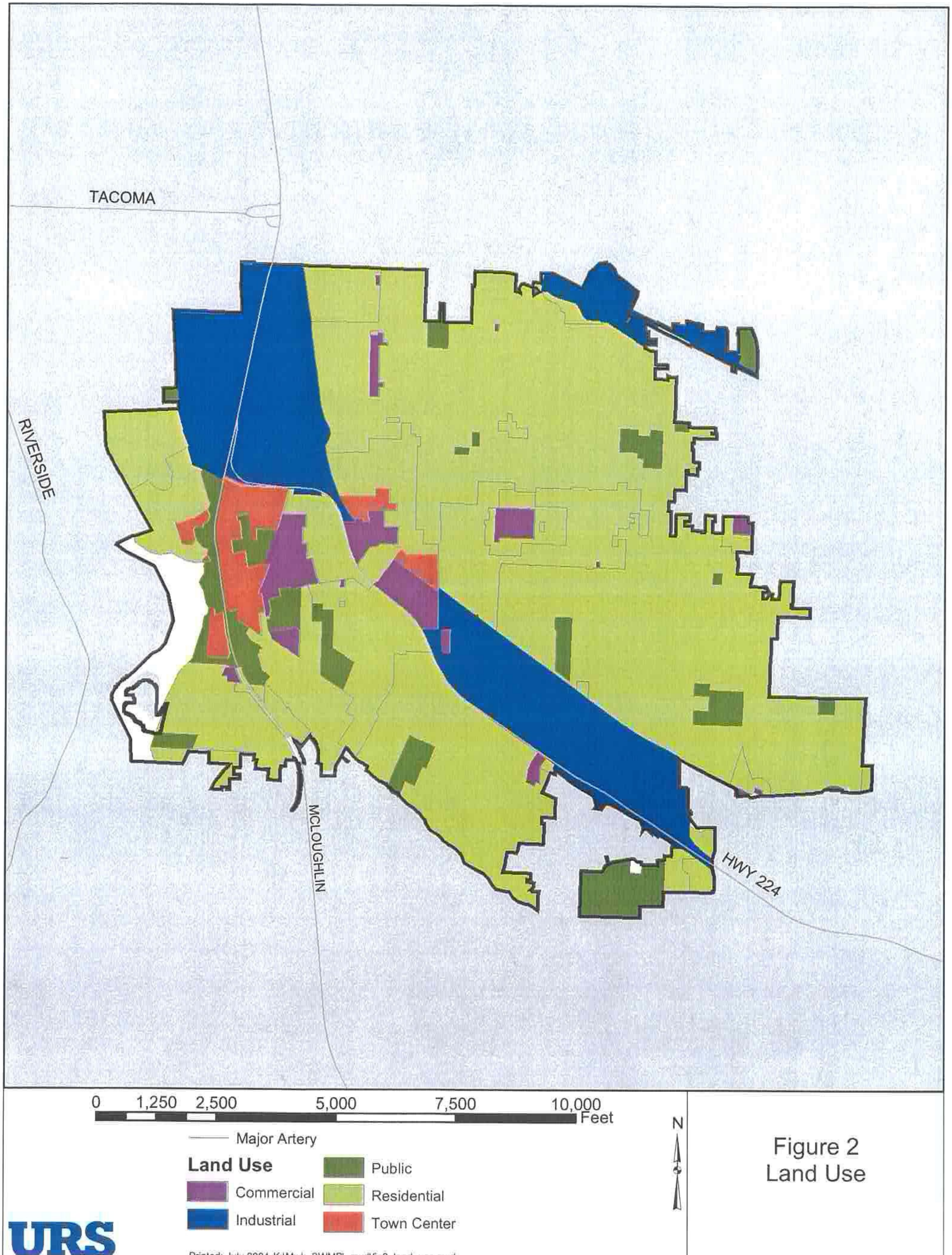

Figure 2
Land Use

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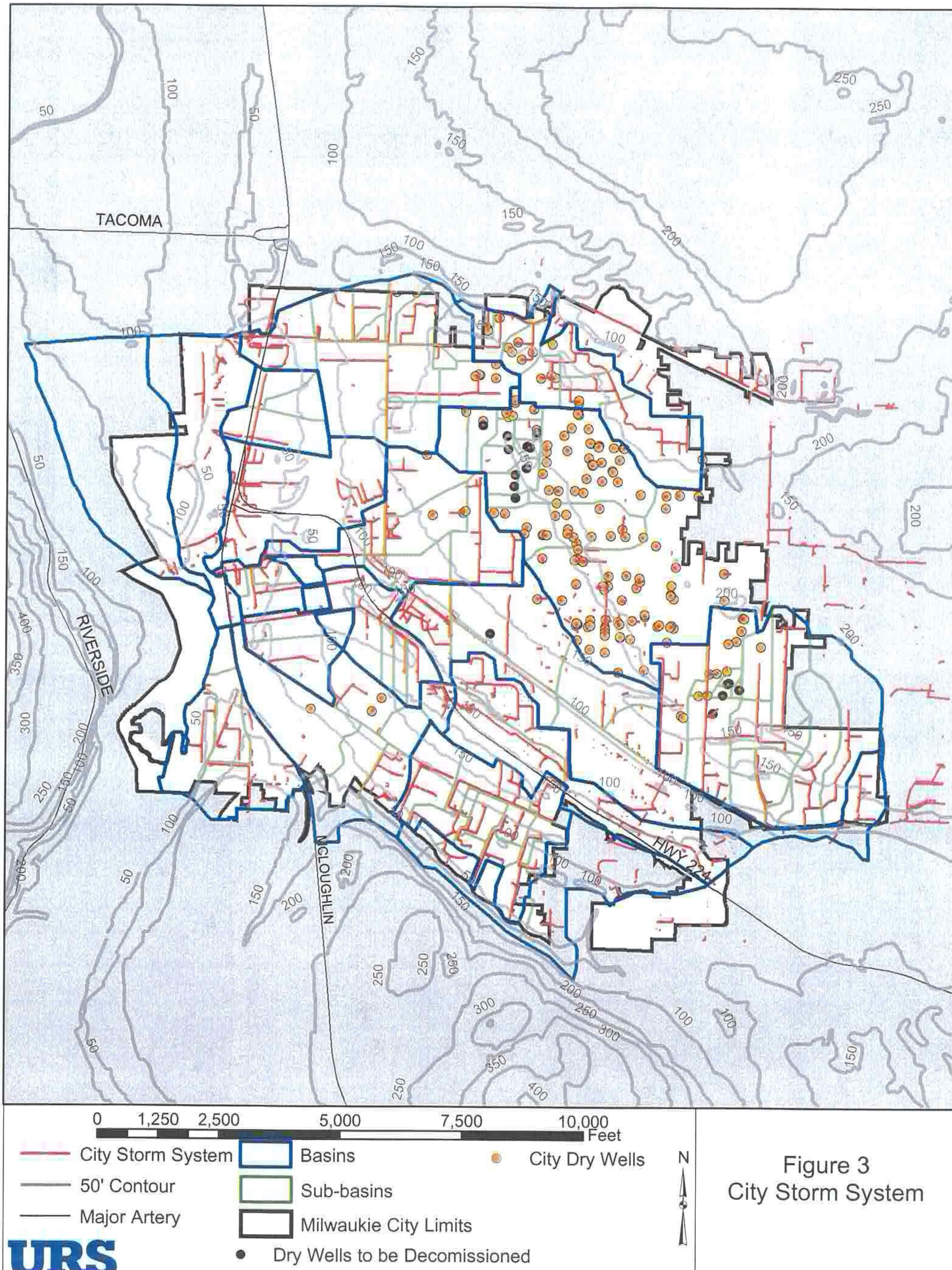

Figure 3
City Storm System

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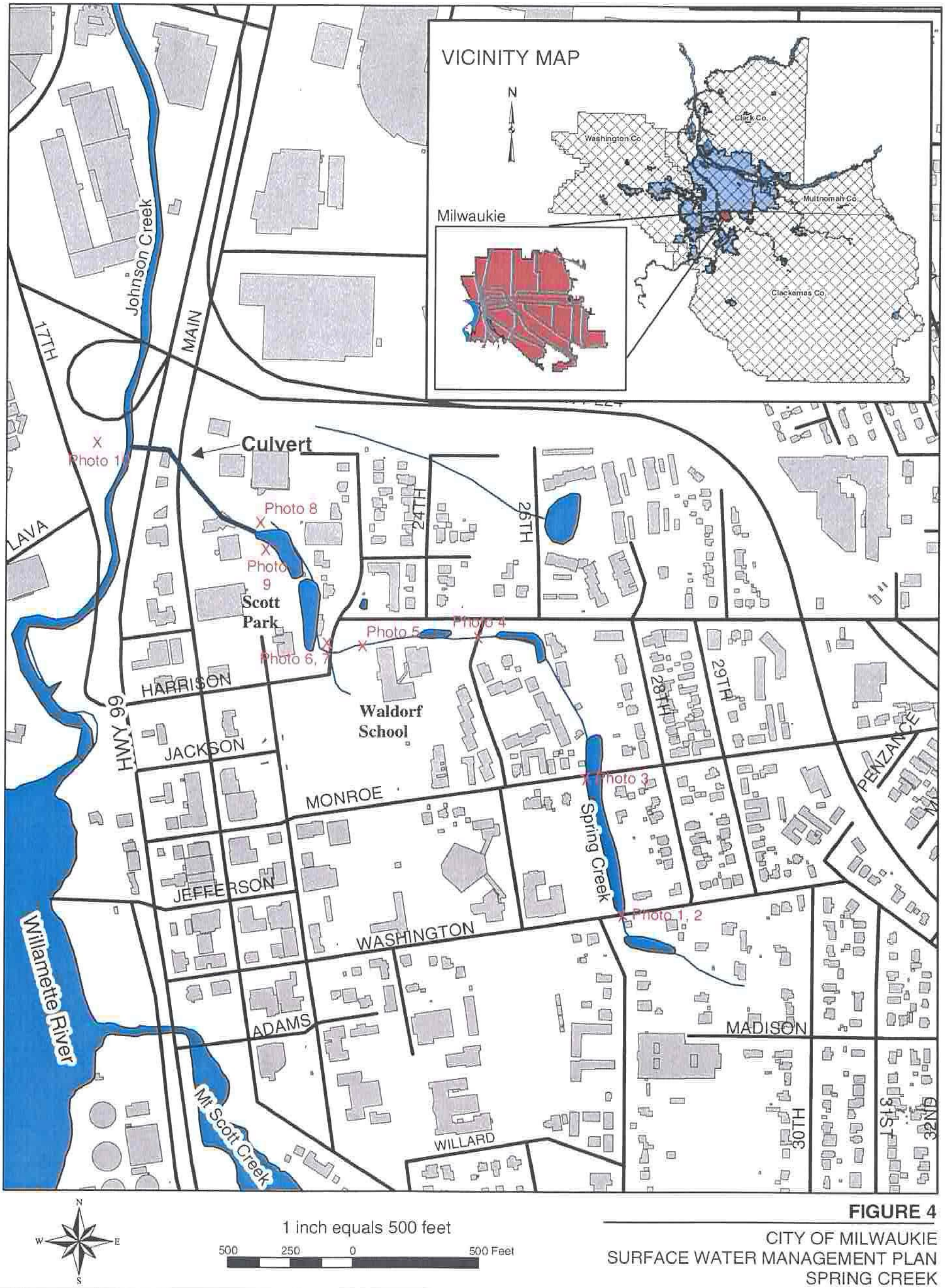

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1 inch equals 500 feet

500 250 0 500 Feet

FIGURE 4

CITY OF MILWAUKIE
SURFACE WATER MANAGEMENT PLAN
SPRING CREEK

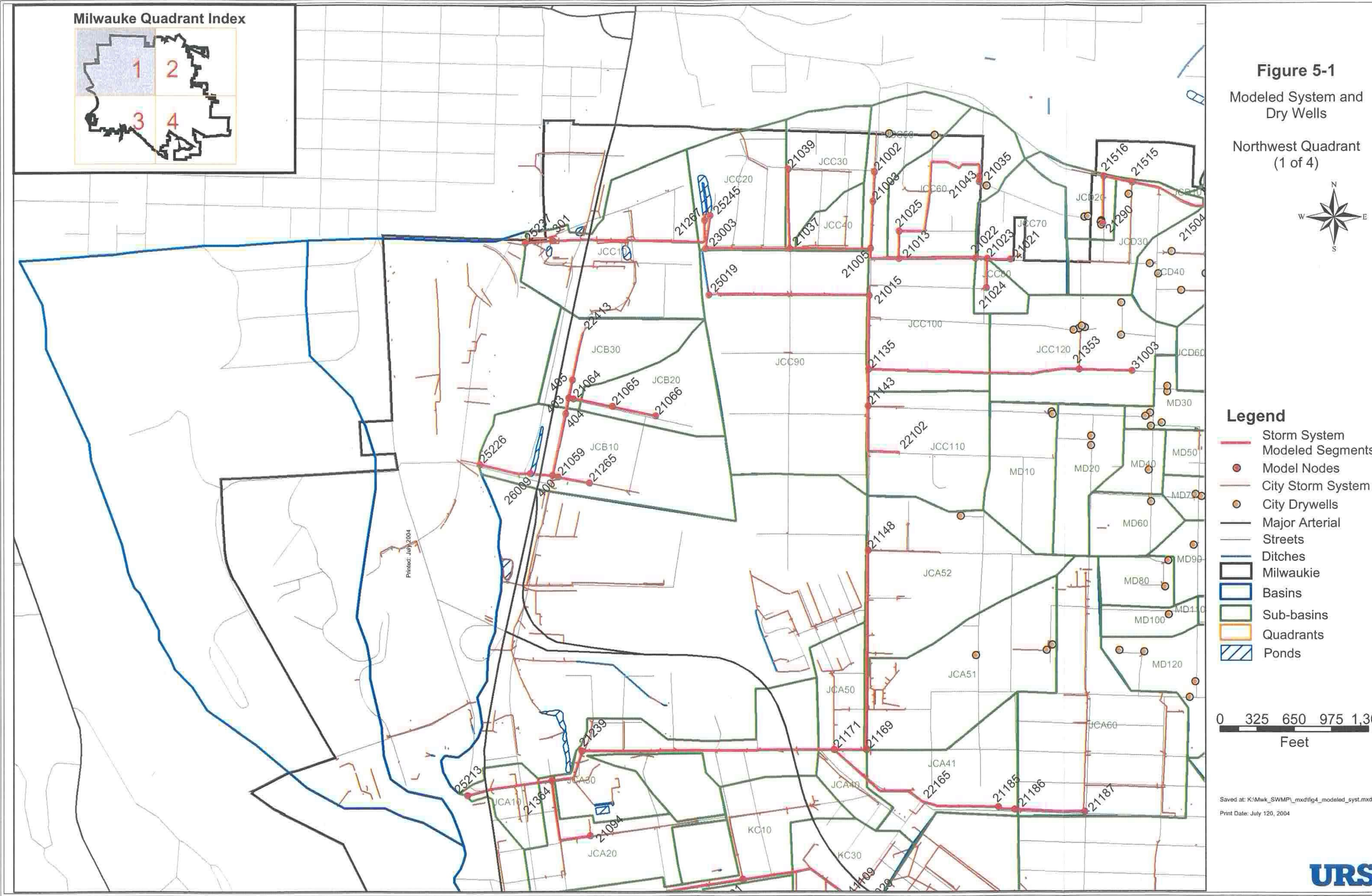

Figure 5-1

Modeled System and Dry Wells

Northwest Quadrant (1 of 4)

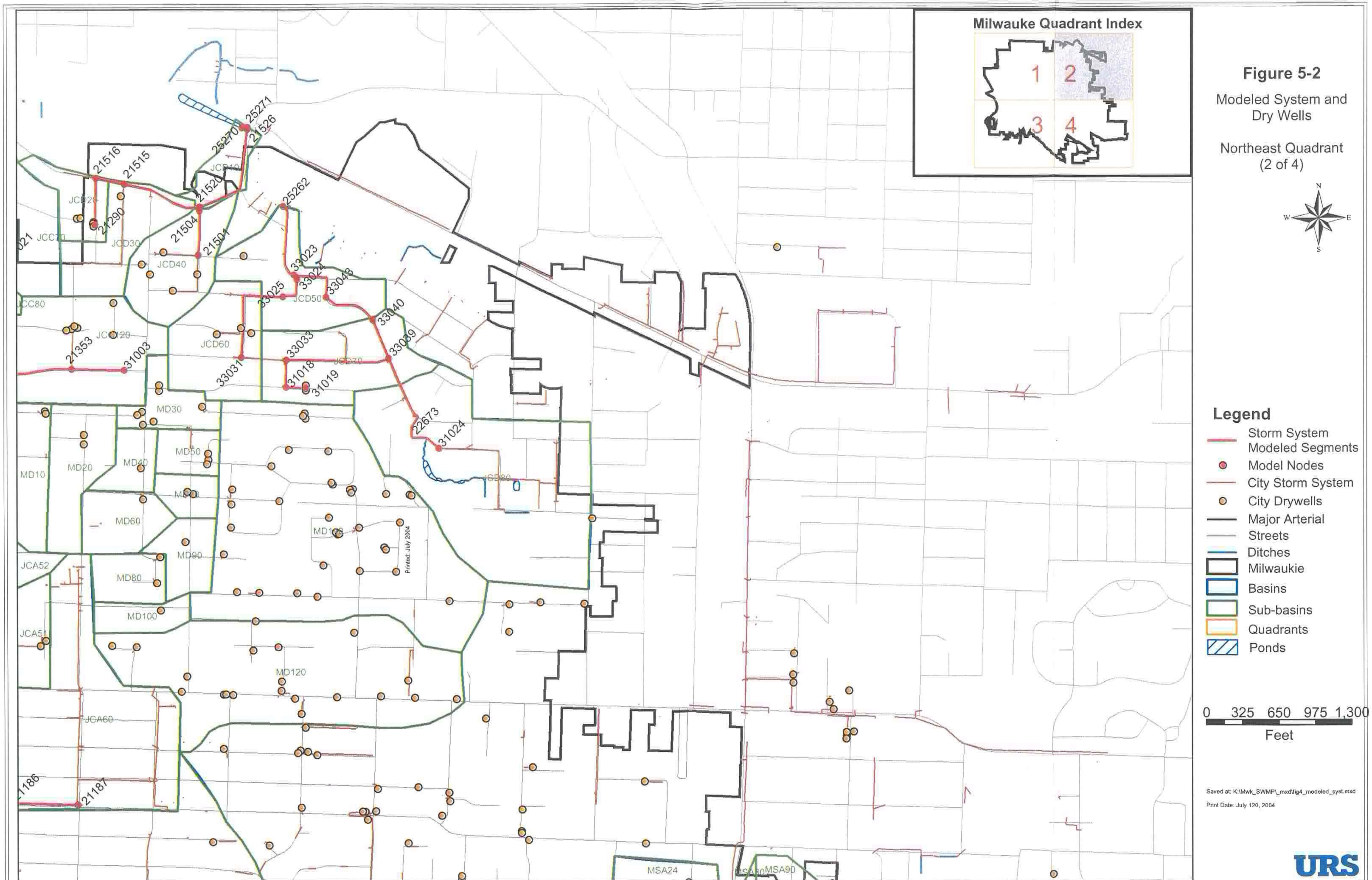

Figure 5-2
Modeled System and Dry Wells
Northeast Quadrant (2 of 4)

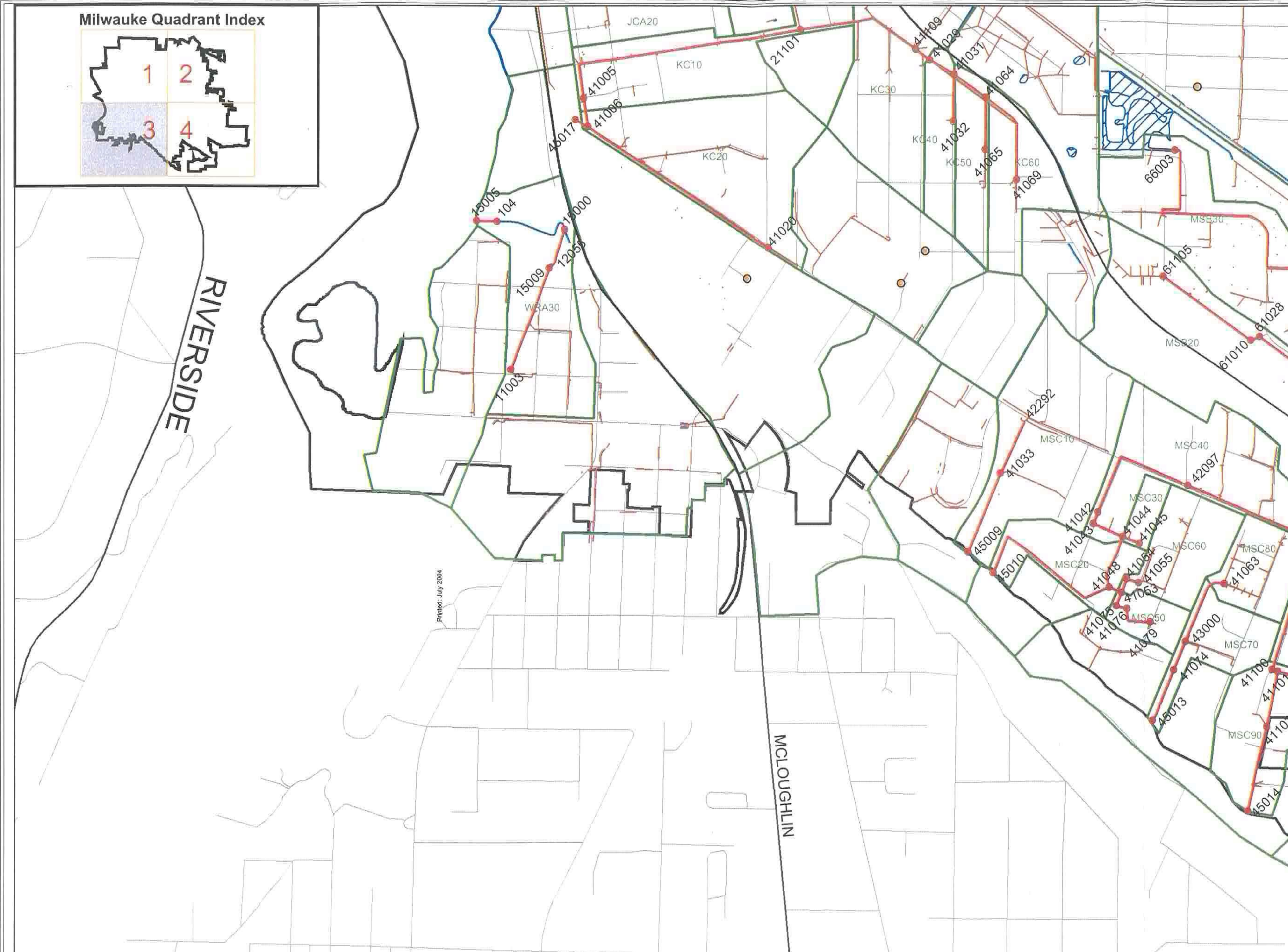

Figure 5-3

Modeled System and Dry Wells

Southwest Quadrant (3 of 4)

N
W
E
S

Legend

- Storm System Modeled Segments
- Model Nodes
- City Storm System
- City Drywells
- Major Arterial
- Streets
- Ditches
- Milwaukie
- Basins
- Sub-basins
- Quadrants
- Ponds

0 325 650 975 1,300

Feet

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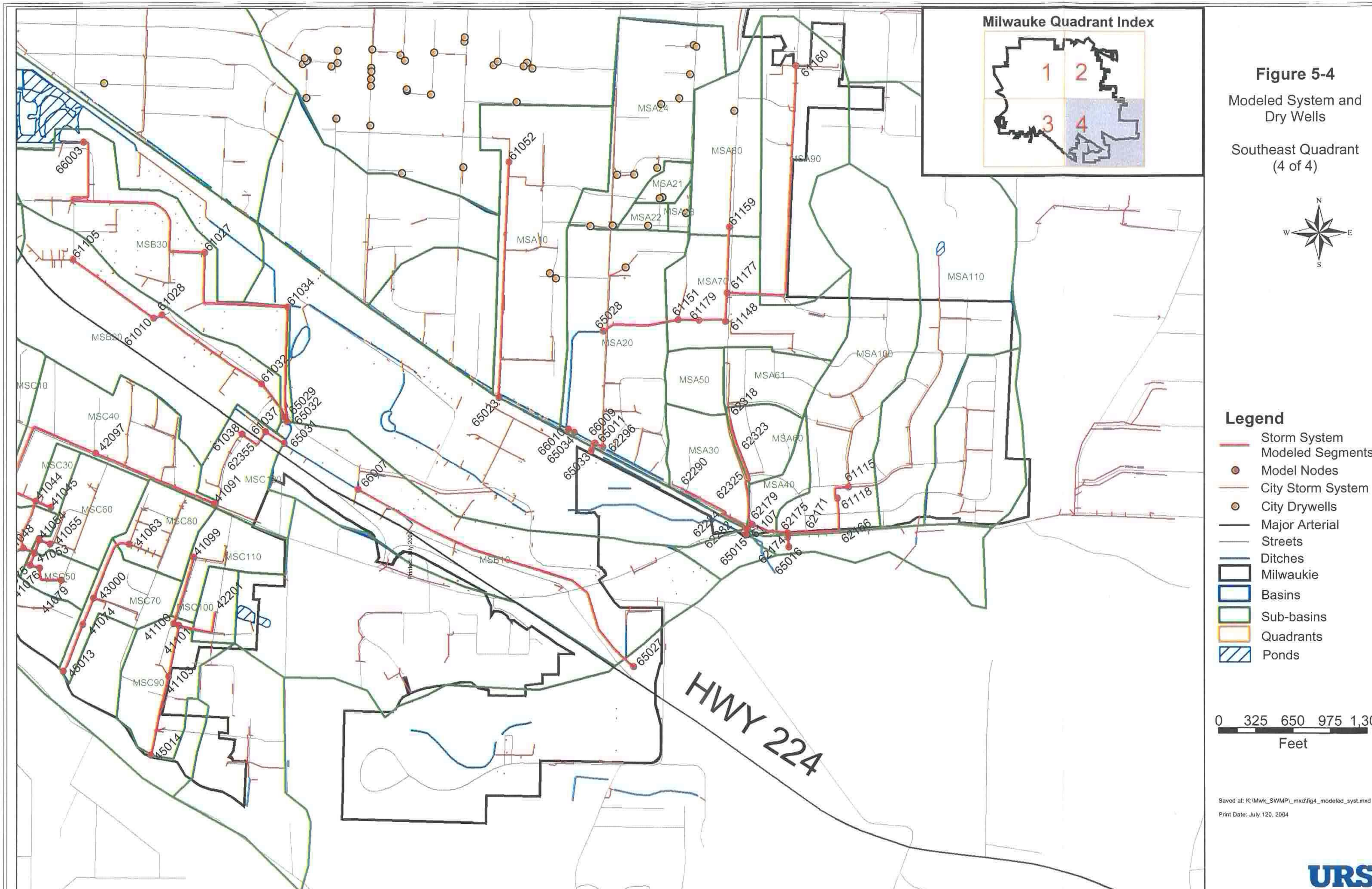

Figure 5-4

Modeled System and Dry Wells

Southeast Quadrant (4 of 4)

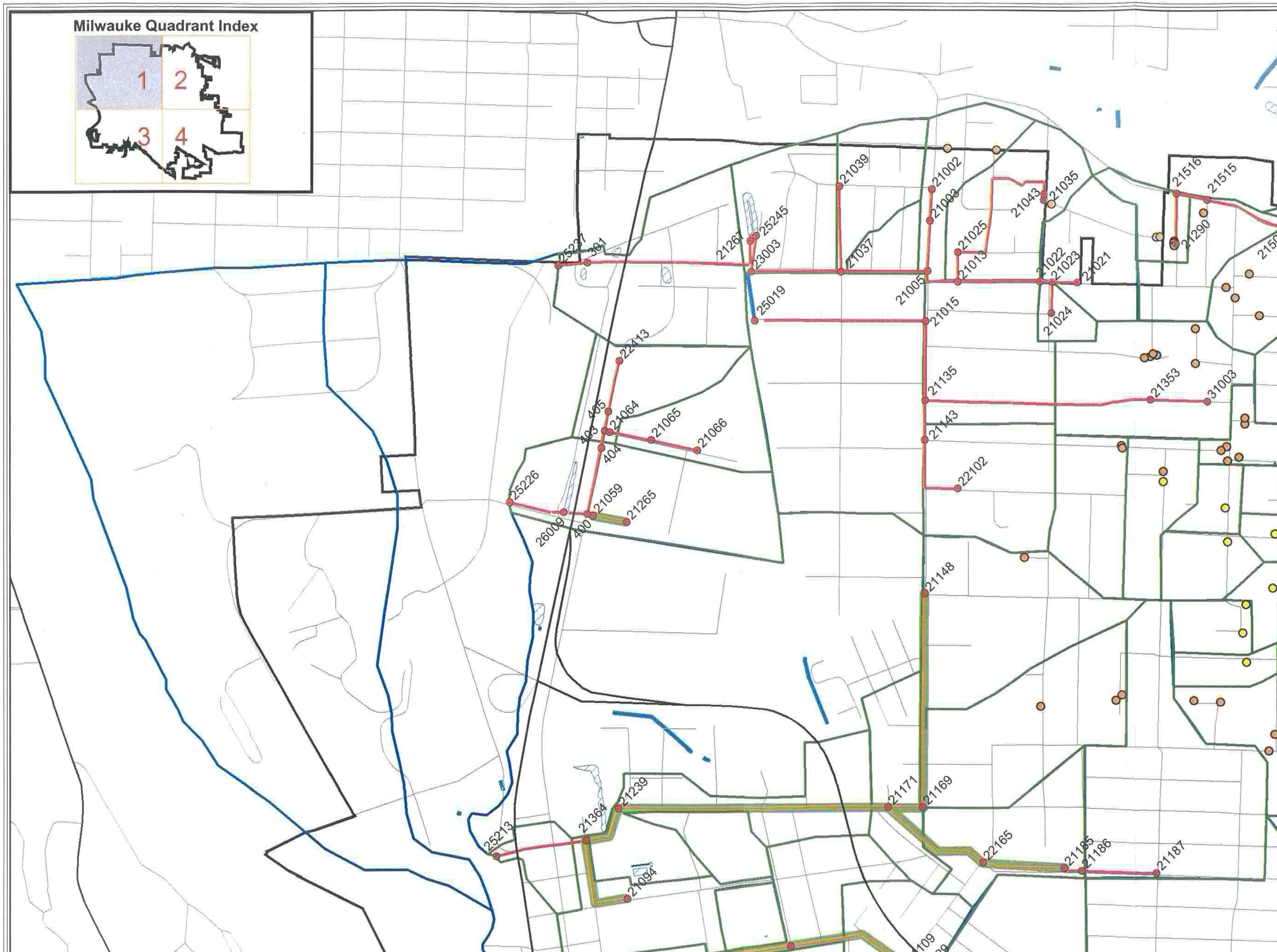

Figure 6-1

Model Results

Northwest Quadrant
(1 of 4)

N
W
E
S

Legend

- City Drywells
- Drywells to be Decomissioned
- Model Nodes
- Expected Flooding Problem
- Storm System Modeled Segments
- Major Arterial
- Streets
- Milwaukie City Limits
- Basins
- Sub-basins
- Quadrants
- Ditches
- Ponds

0 300 600 900 1,200
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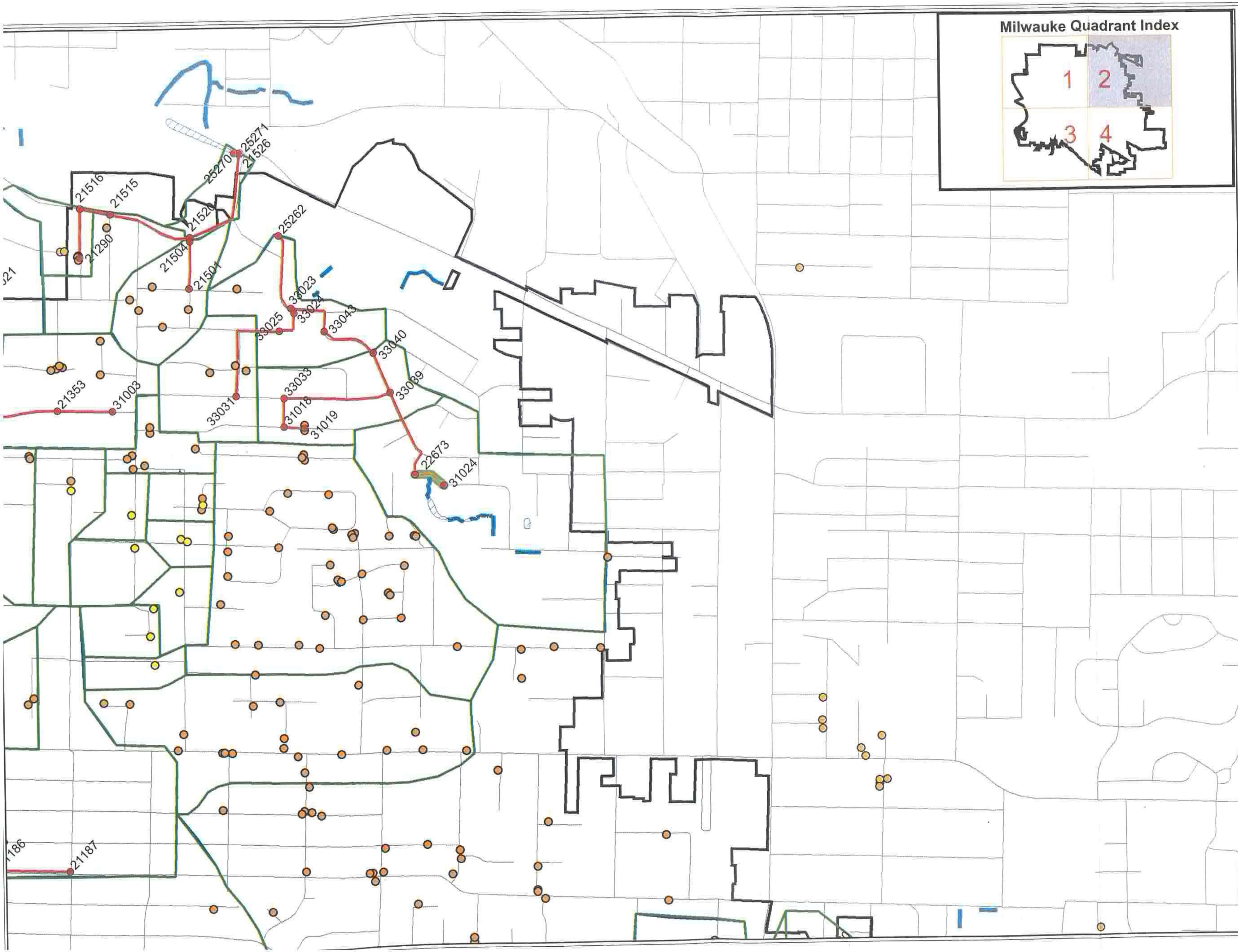

Figure 6-2

Model Results

Northeast Quadrant
(2 of 4)

N
W E
S

Legend

- City Drywells
- Drywells to be Decomissioned
- Model Nodes
- Expected Flooding Problem
- Storm System Modeled Segments
- Major Arterial
- Streets
- Milwaukie City Limits
- Basins
- Sub-basins
- Quadrants
- Ditches
- Ponds

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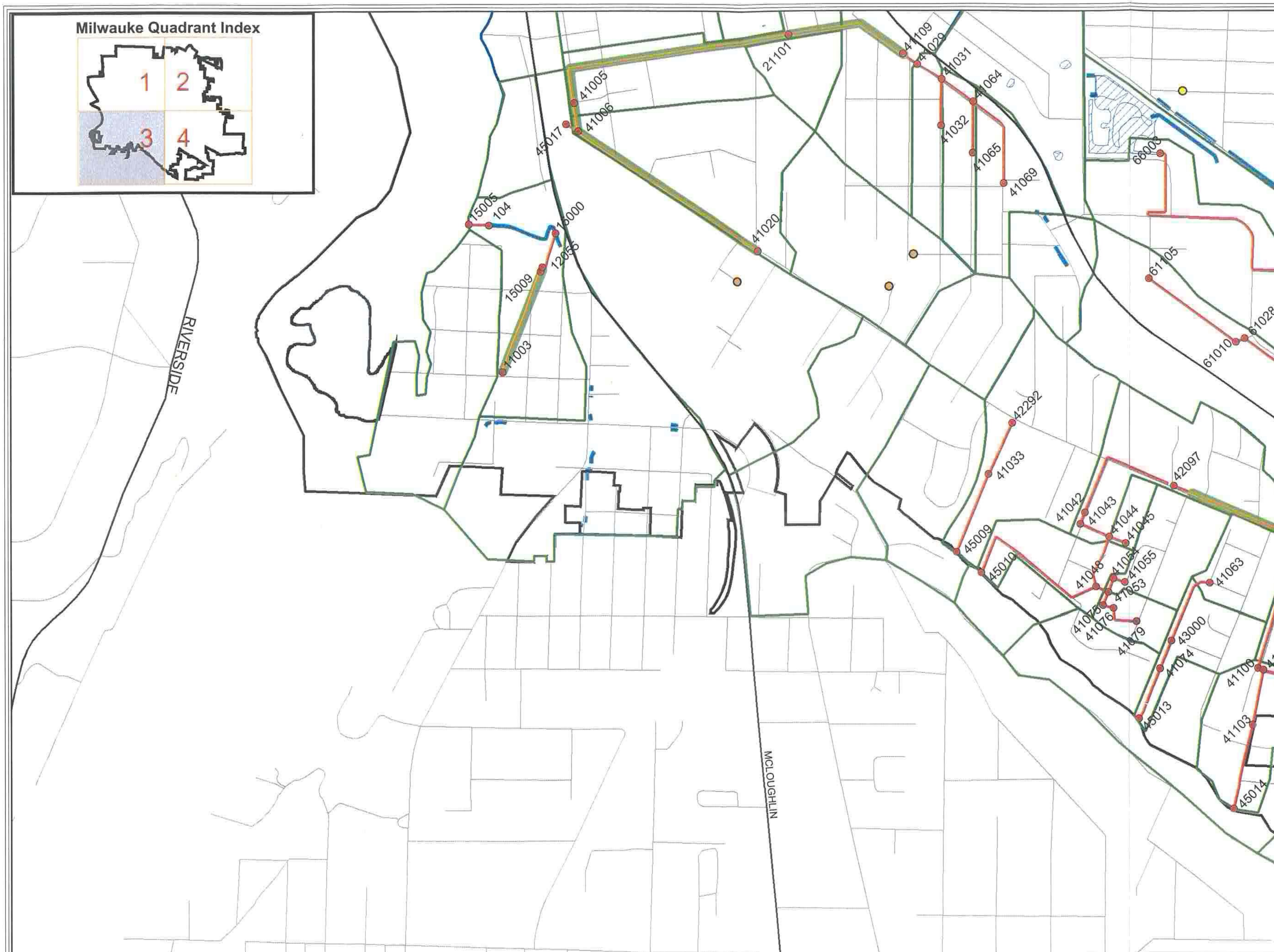

Figure 6-3

Model Results

Southwest Quadrant
(3 of 4)

N
W E
S

Legend

- City Drywells
- Drywells to be Decomissioned
- Model Nodes
- Expected Flooding Problem
- Storm System Modeled Segments
- Major Arterial
- Streets
- Milwaukie City Limits
- Basins
- Sub-basins
- Quadrants
- Ditches
- Ponds

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Feet

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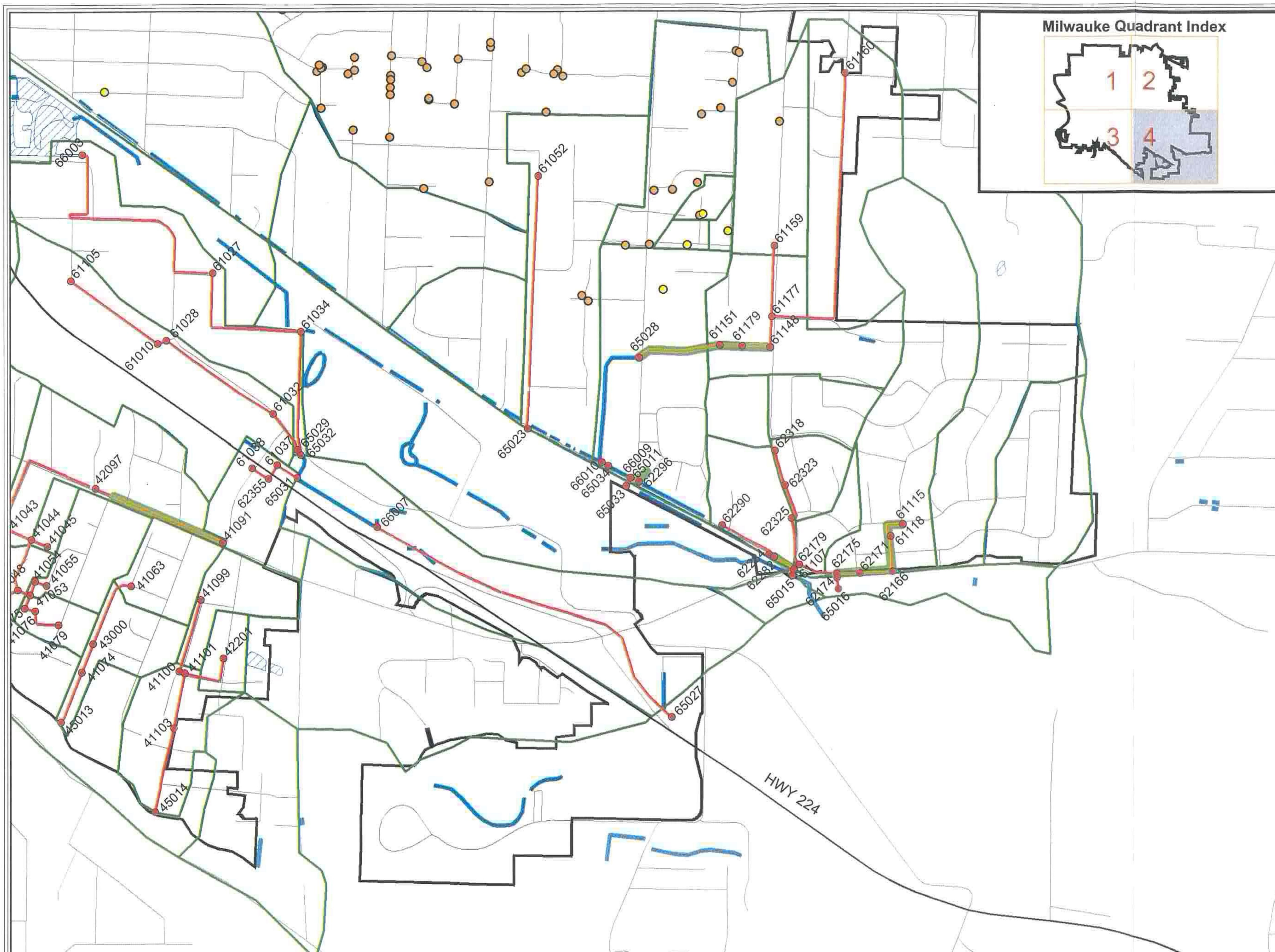

Figure 6-4

Model Results

Southeast Quadrant
(4 of 4)

N
W E
S

Legend

- City Drywells
- Drywells to be Decomissioned
- Model Nodes
- Expected Flooding Problem
- Storm System Modeled Segments
- Major Arterial
- Streets
- Milwaukie City Limits
- Basins
- Sub-basins
- Quadrants
- Ditches
- Ponds

0 300 600 900 1,200
Feet

Saved at: K:\Mwk_SWMP_mxd\fig6_model_results.mxd

Print Date: July 20, 2004

URS

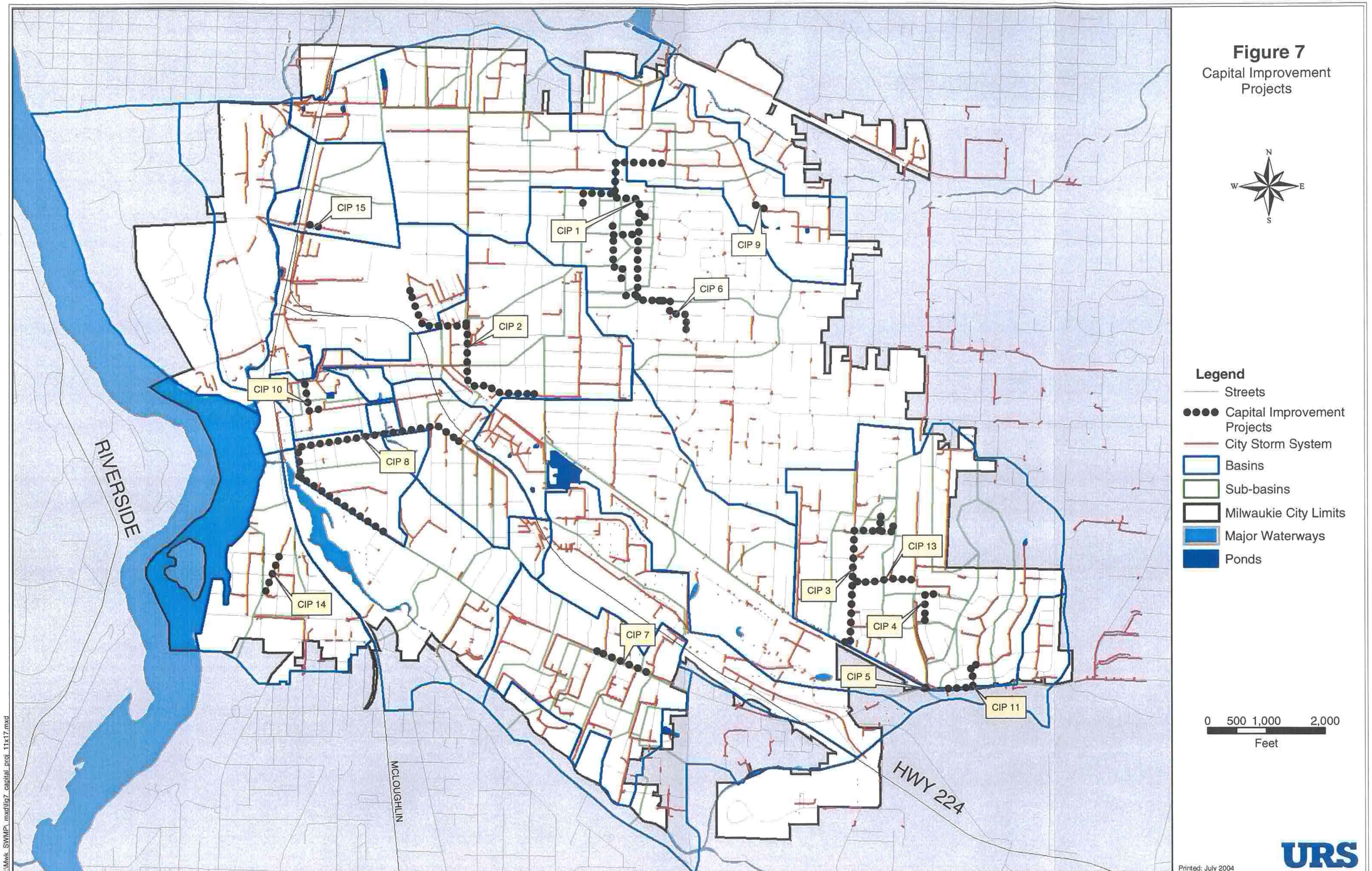

Figure 7
Capital Improvement Projects
N
E
S
W
Legend
Streets
Capital Improvement Projects
City Storm System
Basins
Sub-basins
Milwaukie City Limits
Major Waterways
Ponds
0 500 1,000 2,000
Feet
CIP 1
CIP 2
CIP 3
CIP 4
CIP 5
CIP 6
CIP 7
CIP 8
CIP 9
CIP 10
CIP 11
CIP 13
CIP 14
CIP 15
RIVERSIDE
MCLOUGHLIN
HWY 224
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APPENDIX A

HYDROLOGIC SUMMARY TABLES

Appendix A

MAJOR HYDROLOGIC INPUT DATA FOR MILWAUKIE STORM DRAINAGE SYSTEM

Node	Subbasin Name	Subbasin Area (acres)	Impervious Area (%)	Average Subbasin Slope (ft/ft)	Pervious Curve Number CN
31019	JCD70	20.6	28.0	0.007	59
31024	JCD80	60.9	29.4	0.009	54
33023	JCD50	19.6	28.8	0.014	60
33031	JCD60	17.5	28.0	0.003	59
21290	JCD20	7.3	28.0	0.009	53
21501	JCD40	15.3	28.6	0.006	59
21515	JCD30	14.1	28.0	0.004	57
21520	JCD10	5.8	39.5	0.020	57
301	JCC10	36.2	52.0	0.007	54
21002	JCC50	13.5	32.9	0.003	50
21015	JCC100	27.9	29.8	0.005	58
21021	JCC70	16.3	29.3	0.005	58
21024	JCC80	4.0	34.1	0.002	59
21035	JCC60	22.8	28.0	0.004	56
21037	JCC40	5.4	44.0	0.008	49
21039	JCC30	14.5	44.2	0.008	49
21267	JCC20	19.6	44.6	0.018	54
22102	JCC110	24.3	29.2	0.007	51
25019	JCC90	62.0	32.5	0.013	50
31003	JCC120	31.4	28.2	0.002	59
21066	JCB20	15.6	52.0	0.005	50
21265	JCB10	35.2	52.0	0.005	64
22413	JCB30	15.6	52.0	0.003	49
21094	JCA20	19.0	55.2	0.009	59
21148	JCA50, JCA5, & JCA52*	82.5	39.0	0.009	52
21171	JCA40 & JCA41*	27.7	47.9	0.009	56
21187	JCA60	49.1	42.3	0.007	49
21239	JCA30	28.7	53.9	0.007	59
21364	JCA10	7.2	48.2	0.005	59
21101	KC10	34.6	54.6	0.007	53
41020	KC20	33.7	52.9	0.011	51
41032	KC40	8.1	44.0	0.011	54
41065	KC50	9.4	42.7	0.012	54
41069	KC60	14.1	40.1	0.011	56

APPENDIX B

HYDRAULIC SUMMARY TABLES

Appendix B

HYDRAULIC PERFORMANCE OF MILWAUKIE STORM DRAINAGE SYSTEM UNDER EXISTING LAND USE CONDITIONS

Structure ID	Model Sequence	Summary Sequence	Node ID		Structure Size/Type	Structure Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions				Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)								Ground Elevation (ft)	
														10-Year		25-Year		50-Year		100-Year			
			US	DS				10-Year	25-Year	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
System #1																							
JDC80b.1	1	1	31024	22673	15-in Dia	282.1	25	5.1	7.0	7.1	7.1	119.3	119.0	122.8	119.7	124.1	120.0	124.1	122.2	124.2	123.0	125.0	124.0
JDC80b-rd	2	2	31024	22673	Roadway	282.1		0.0	1.3	6.3	9.4	124.0	122.0	119.7	119.7	124.1	122.1	124.1	122.2	124.2	123.0	125.0	124.0
JDC80a.1	3	3	22673	33039	18-in Dia	786.4	25	5.1	8.3	10.7	11.1	119.0	109.9	119.7	111.1	120.0	111.7	122.2	112.2	123.0	112.5	124.0	115.3
JDC80a-rd	4	4	22673	33039	Roadway	786.4		0.0	0.0	0.0	1.1	123.0	114.3	111.1	111.1	111.7	111.7	112.2	112.2	123.0	114.3	124.0	115.3
JDC70d.1	5	5	31019	31018	18-in Dia	177.3	25	3.5	5.2	6.6	7.8	152.9	151.5	153.6	152.7	153.8	153.1	154.1	153.4	154.8	153.7	157.0	157.0
JDC70d-rd	6	6	31019	31018	Roadway	177.3		0.0	0.0	0.0	0.0	156.0	156.0	152.7	152.7	153.1	153.1	153.4	153.4	153.7	153.7	157.0	157.0
JDC70c	7	7	31018	33033	18-in Dia	241.9	25	3.5	5.2	6.6	7.8	151.5	151.4	152.7	152.1	153.1	152.3	153.4	152.4	153.7	152.5	157.0	156.0
JDC70b	8	8	33033	33039	24-in Dia	923.8	25	3.5	5.2	6.6	7.8	151.1	110.1	151.4	111.1	151.5	111.7	151.5	112.2	151.6	112.5	156.0	115.3
JDC70a.1	9	9	33039	33040	24-in Dia	370.2	25	7.0	10.8	14.1	15.7	109.7	109.4	111.1	110.4	111.7	110.6	112.2	110.8	112.5	110.8	115.3	115.0
JDC70a-rd	10	10	33039	33040	Roadway	370.2		0.0	0.0	0.0	0.0	114.3	114.0	110.0	110.0	110.2	110.2	110.4	110.4	110.6	110.6	115.3	115.0
JCD50c	11	11	33040	33043	24-in Dia	493.8	25	7.0	10.8	14.1	15.7	109.2	104.1	110.0	106.8	110.2	107.1	110.4	107.1	110.6	107.5	115.0	113.5
JCD50b	12	12	33043	33023	36-in Dia	476.2	25	7.0	10.8	14.1	15.8	106.0	104.4	106.8	105.2	107.1	105.4	107.1	106.2	107.5	107.2	113.5	111.0
JDC60	13	13	33031	33025	36-in Dia	907.6	25	1.9	2.8	3.6	4.2	144.2	143.5	145.0	143.7	145.2	143.7	145.3	143.8	145.4	143.8	157.0	154.0
JCD50e	14	14	33025	33024	24-in Dia	262.9	25	1.9	2.8	3.6	4.2	143.5	104.6	143.7	105.3	143.7	105.5	143.8	106.2	143.8	107.2	154.0	110.0
JCD50d	15	15	33024	33023	36-in Dia	51.3	25	1.9	2.8	3.6	4.2	104.6	104.4	105.3	105.2	105.5	105.4	106.2	106.2	107.2	107.2	110.0	111.0
JCD50a	16	16	33023	25262	48-in Dia	662.5	25	11.0	16.9	22.0	24.7	104.4	101.3	105.2	103.8	105.4	105.1	106.2	106.0	107.2	107.0	111.0	107.0
System #2																							
JCD20	1	20	21290	21516	18-in Dia	413.4	25	0.5	0.9	1.3	1.6	142.9	140.3	143.1	140.5	143.2	140.6	143.3	140.6	143.3	140.7	150.0	151.5
JCD30b	2	21	21516	21515	21-in Dia	252.9	25	0.5	0.9	1.3	1.6	140.3	137.5	140.5	138.0	140.6	138.1	140.6	138.2	140.7	138.2	151.5	149.0
JCD30a	3	22	21515	21520	24-in Dia	725.9	25	2.1	3.5	4.8	5.7	137.5	119.6	138.0	119.6	138.1	119.8	138.2	120.0	138.2	120.2	149.0	129.0
JCD40b	4	23	21501	21504	18-in Dia	398.3	25	5.2	5.5	5.0	5.9	139.7	119.6	140.0	123.6	140.1	122.9	140.1	121.8	140.2	121.6	148.0	130.0
JCD40a	5	24	21504	21520	24-in Dia	30.8	25	2.9	4.1	5.1	5.9	119.6	119.6	123.6	119.6	122.9	119.8	121.8	120.0	121.6	120.2	130.0	129.0
JCD10c.1	6	25	21520	21526	24-in Dia	967.1	25	6.0	8.9	11.6	13.7	119.6	94.3	119.6	101.1	119.8	101.8	120.0	102.2	120.2	102.8	129.0	103.0
JCD10c-rd	7	26	21520	21526	Roadway	967.1		0.0	0.0	0.0	0.0	128.0	102.0	101.1	101.1	101.8	101.8	102.2	102.2	102.8	102.8	129.0	103.0
JCD10a	8	27	21526	25270	15-in Dia	275.6	25	5.2	6.0	6.5	7.2	98.7	97.7	101.1	98.6	101.8	98.7	102.1	98.7	102.8	98.8	103.0	100.0
JCD10b	9	28	21526	25271	24-in Dia	24	25	-5.4	-6.4	-13.3	-7.2	94.3	92.8	101.1	101.0	101.8	101.7	102.1	102.0	102.8	102.8	103.0	103.0
System #3																							
JCC60c	1	30	21035	21043	18-in Dia	46.3	25	-2.0	-3.2	-4.2	-5.0	141.8	142.1	142.7	142.6	142.9	142.7	143.0	142.8	143.1	142.9	148.0	148.0
JCC60b	2	31	21043	21025	24-in Dia	1401.8	25	2.0	3.2	4.2	5.1	142.1	133.7	142.6	134.2	142.7	134.3	142.8	134.4	142.9	134.5	148.0	142.0
JCC60a	3	32	21025	21013	30-in Dia	243.4	25	2.0	3.2	4.2	5.0	133.7	132.8	134.2	133.7	134.3	133.9	134.4	134.1	134.5	134.2	142.0	139.5
JCC70	4	33	21021	21023	15-in Dia	205.6	25	1.8	2.7	3.5	4.4	147.3	143.7	147.7	144.6	147.8	145.0	147.9	145.3	147.9	145.7	154.0	152.5
JCC80	5	34	21024	21023	15-in Dia	257.3	25	0.5	0.7	0.9	1.1	145.5	143.7	145.8	144.6	145.8	145.0	145.9	145.3	145.9	145.7	151.7	152.5
JCC60e	6	35	21023	21022	15-in Dia	104	25	2.3	3.4	4.3	5.1	143.7	143.6	144.6	144.0	145.0	144.1	145.3	144.2	145.7	144.3	152.5	152.0
JCC60d	7	36	21022	21013	18-in Dia	675.5	25	2.3	3.4	4.3	5.1	143.6	132.8	144.0	133.7	144.1	133.9	144.2	134.1	144.3	134.2	152.0	139.5
JCC50c	8	37	21013	21005	36-in Dia	337.3	25	4.3	6.5	8.5	10.1	132.8	131.8	133.7	132.2	133.9	132.4	134.1	132.4	134.2	132.5	139.5	142.5
JCC50b	9	38	21002	21003	15-in Dia	257	25	0.9	3.6	2.0	2.4	138.9	138.0	139.4	138.3	140.3	138.5	139.7	138.4	139.8	138.4	143.0	144.0
JCC50a	10	39	21003	21005	15-in Dia	414.8	25	0.9	3.6	2.0	2.4	138.0	131.8	138.3	132.2	138.5	132.4	138.4	132.4	138.4	132.5	144.0	142.5
JCC40	11	40	21005	21037	36-in Dia	698.5	25	5.1	10.0	10.5	12.6	131.8	107.8	132.2	108.3	132.4	108.4	132.4	108.4	132.5	108.5	142.5	117.0
JCC30	12	41	21039	21037	20-in Dia	698.4	25	3.9	4.8	5.6	6.2	119.5	107.8	120.1	108.3	120.1	108.4	120.2	108.4	120.2	108.5	131.0	117.0
JCC20c	13	42	21037	23003	36-in Dia	744.5	25	9.0	15.2	16.6	19.5	107.8	56.9	108.3	59.0	108.4	59.7	108.4	60.1	108.5	60.5	117.0	65.0
JCC110b	14	43	22102	21143	18-in Dia	672.3	25	1.5	2.5	3.6	4.4	146.5	139.2	146.9	139.6	147.0	139.8	147.1	139.9	147.2	140.0	149.0	152.6
JCC110a	15	44	21143	21135	24-in Dia	325.4	25	1.5	2.5	3.6	4.4	139.2	137.9	139.6	138.4	139.8	138.6	139.9	138.7	140.0	138.7	152.6	145.8
JCC120.1	16	45	31003	21353	15-in Dia	467.1	25	3.6	5.4	6.9	8.2	152.0	146.5	152.6	147.2	152.7	147.3	152.9	147.5	153.0	147.5	156.8	155.5
JCC120-rd	17	46	31003	21353	Roadway	467.1		0.0	0.0	0.0	0.0	155.8	154.4	147.2	147.2	147.3	147.3	147.5	147.5	147.5	147.5	156.8	155.5
JCC100b	18	47	21353	21135	24-in Dia	1866.9	25	3.6	5.4	6.9	8.1	146.5	137.9	147.2	138.4	147.3	138.6	147.5	138.7	147.5	138.7	155.5	145.8

Structure ID	Model Sequence	Summary Sequence	Node ID		Structure Size/Type	Structure Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions				Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)								Ground Elevation (ft)	
														10-Year		25-Year		50-Year		100-Year			
			US	DS				10-Year	25-Year	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
JCC100a.1	19	48	21135	21015	30-in Dia	651.2	25	5.0	7.9	10.5	12.5	137.9	126.5	138.4	127.1	138.6	127.2	138.7	127.4	138.7	127.4	145.8	137.0
JCC100a-rd	20	49	21135	21015	Roadway	651.2		0.0	0.0	0.0	0.0	144.8	136.0	127.1	127.1	127.2	127.2	127.4	127.4	127.4	127.4	145.8	137.0
JCC90b.1	21	50	21015	25019	24-in Dia	1404	25	8.0	12.5	16.4	19.6	126.5	67.0	127.1	67.6	127.2	67.8	127.4	67.9	127.4	68.0	137.0	71.0
JCC90b-rd	22	51	21015	25019	Roadway	1404		0.0	0.0	0.0	0.0	136.0	70.0	67.6	67.6	67.8	67.8	67.9	67.9	68.0	68.0	137.0	71.0
JCC90a	23	52	25019	23003	Natural	409.4	25/NA	12.4	19.9	26.7	32.2	67.0	56.9	67.6	59.0	67.8	59.7	67.9	60.1	68.0	60.5	71.0	65.0
JCC20b	24	53	23003	Roswell	48-in Dia	279.4	25	21.1	34.5	42.4	50.3	56.9	56.0	59.0	57.4	59.7	57.7	60.1	57.9	60.5	58.1	65.0	60.0
Roswell Outlet	25	54																					
JCC20a	26	55	25245	21267	30-in Dia	55.33	25	12.7	20.3	25.9	32.0	52.5	51.1	53.7	51.1	53.8	51.7	53.9	52.1	54.1	52.6	60.0	61.5
JCC10b.1	27	56	21267	301	42-in Dia	1323.9	25	14.4	22.7	28.8	35.5	51.1	38.1	51.1	46.5	51.7	47.3	52.1	48.2	52.6	48.5	61.5	48.5
JCC10b-rd	28	57	21267	301	Roadway	1323.9		0.0	0.0	0.0	0.0	59.0	46.0	46.5	46.5	47.3	47.3	48.2	48.2	48.5	48.5	61.5	48.5
JCC10a	29	58	301	25237	48-in Dia	242	25	-83.4	27.0	34.1	-102.3	38.1	35.7	46.4	45.6	47.3	47.2	48.2	48.0	48.5	50.0	48.5	50.0
System #4																							
JCB10d.1	1	60	21265	21059	12x24-in Dia	306.7	25	7.5	7.5	7.5	7.3	37.7	35.0	41.3	38.3	41.3	39.3	41.4	40.7	41.8	41.8	42.0	43.0
JCB10d-rd	2	61	21265	21059	Roadway	306.7		-11.9	-16.7	-21.4	-24.5	40.0	41.0	41.3	41.2	41.3	41.3	41.4	41.3	41.8	41.8	42.0	43.0
JCB10c	3	62	21059	400	24-in Dia	72.5	25	17.6	21.4	24.3	23.5	35.0	34.5	38.3	35.7	39.3	35.8	40.7	36.0	41.8	37.7	43.0	41.0
JCB30b.1	4	63	22413	405	18-in Dia	410.1	25	6.1	7.6	8.8	9.4	42.3	40.3	43.6	41.1	44.7	41.2	45.6	41.2	46.0	41.3	47.0	45.2
JCB30b-rd	5	64	22413	405	Roadway	410.1		0.0	0.0	0.0	0.1	46.0	44.2	41.1	41.1	41.2	41.2	41.2	41.2	46.0	44.2	47.0	45.2
JCB30a	6	65	405	403	24-in Dia	160.3	25	6.1	7.6	8.8	9.5	40.4	38.5	41.1	39.9	41.2	40.0	41.2	40.2	41.3	40.3	45.2	43.5
JCB20c	7	66	21066	21065	18-in Dia	402.0	25	5.3	6.5	7.6	8.4	45.1	41.2	45.9	42.3	46.0	42.5	46.1	42.6	46.2	42.7	51.0	45.6
JCB20b	8	67	21065	21064	21-in Dia	318.0	25	5.3	6.5	7.6	8.4	41.2	40.0	42.3	40.6	42.5	40.7	42.6	40.8	42.7	40.9	45.6	44.0
JCB20a	9	68	21064	403	18-in Dia	68.6	25	5.3	6.5	7.6	8.4	40.0	38.6	40.6	39.9	40.7	40.0	40.8	40.2	40.9	40.3	44.0	43.5
JCB10f	10	69	403	404	30-in Dia	140.4	25	10.7	13.2	15.2	17.3	38.6	38.0	39.9	39.1	40.0	39.2	40.2	39.3	40.3	39.4	43.5	43.0
JCB10e	11	70	404	400	36-in Dia	555.5	25	10.7	13.2	15.1	17.3	37.8	34.5	38.7	35.7	38.8	35.8	38.9	36.0	39.0	37.7	43.0	41.0
JCB10b	12	71	400	26009	42-in Dia	161.4	25	27.7	33.9	38.8	39.9	34.5	31.9	35.7	33.4	35.8	34.6	36.0	35.9	37.7	37.5	41.0	41.8
JCB10a	13	72	26009	25226	36-in Dia	424.5	25	27.7	33.9	38.8	39.9	31.9	26.0	33.4	32.0	34.6	33.3	35.9	34.0	37.5	35.5	41.8	38.8
System #5																							
JCA50b.1	1	80	21148	21169	15-in Dia	1892.1	25	11.3	11.5	11.5	11.5	137.4	95.1	142.5	101.8	144.1	102.1	144.1	102.1	144.1	102.1	145.0	103.0
JCA50b-rd	2	81	21148	21169	Roadway	1892.1		0.0	4.5	9.9	14.6	144.0	102.0	101.8	101.8	144.1	102.1	144.1	102.1	144.1	102.1	145.0	103.0
JCA50a.1	3	82	21169	21171	18-in Dia	234.0	25	11.3	11.5	11.5	11.5	95.1	92.4	101.8	98.5	102.1	98.6	102.1	98.6	102.1	98.7	103.0	102.5
JCA50a-rd	4	83	21169	21171	Roadway	285.0		0.0	3.7	9.1	13.7	102.0	98.5	98.5	98.5	102.1	98.6	102.1	98.6	102.1	98.7	103.0	102.5
JCA60.1	5	84	21187	21186	18-in Dia	738.3	25	7.9	11.8	15.1	17.8	162.7	120.7	163.6	121.1	163.7	121.2	163.8	121.4	163.9	121.5	167.0	125.0
JCA60-rd	6	85	21187	21186	Roadway	738.3		0.0	0.0	0.0	0.0	166.0	124.0	121.1	121.1	121.2	121.2	121.4	121.4	121.5	121.5	167.0	125.0
JCA40c	7	86	21186	21185	18-in Dia	148.2	25	10.2	11.8	15.1	17.8	120.7	110.2	121.1	116.0	121.2	116.1	121.4	116.1	121.5	116.1	125.0	119.0
JCA40b.1	8	87	21185	21340	12-in Dia	576.8	25	5.6	5.6	5.7	5.7	110.2	97.7	116.0	100.1	116.1	100.2	116.1	100.2	116.1	100.3	119.0	103.0
JCA40b-rd	9	88	21185	21340	Roadway	576.8		2.3	6.2	9.5	12.2	116.0	100.0	116.0	100.1	116.1	100.2	116.1	100.2	116.1	100.3	119.0	103.0
JCA40a.1	10	89	21340	21171	15-in Dia	1040.8	25	4.8	4.8	4.8	4.8	97.7	92.4	100.1	98.5	100.2	98.6	100.2	98.6	100.3	98.7	103.0	102.5
JCA40a-rd	11	90	21340	21171	Roadway	1040.8		2.7	6.2	9.7	12.8	100.0	98.5	100.1	98.6	100.2	98.6	100.2	98.6	100.3	98.7	103.0	102.5
JCA30b.1	12	91	21171	21239	18-in Dia	2264.0	25	16.0	16.0	16.0	16.0	92.4	27.3	98.5	40.4	98.6	41.2	98.6	42.2	98.7	43.4	102.5	43.5
JCA30b-rd	13	92	21171	21239	Roadway	2209.0		4.7	13.3	23.5	32.7	98.5	39.5	98.5	40.4	98.6	41.2	98.6	42.2	98.7	43.4	102.5	43.5
JCA30a.1	14	93	21239	21364	24-in Dia	440.0	25	16.0	15.5	15.6	13.7	27.0	26.6	40.4	38.2	41.2	41.2	42.2	42.2	43.4	43.4	43.5	43.5
JCA30a-rd	15	94	21239	21364	Roadway	458.4		0.0	-20.3	-22.9	-26.1	39.5	40.5	40.4	40.4	41.2	41.2	42.2	42.2	43.4	43.4	43.5	43.5
JCA20.1	16	95	21094	21364	15-in Dia	785.0	25	4.4	4.1	3.9	3.7	34.1	31.3	42.0	38.2	42.1	41.2	42.2	42.2	43.4	43.4	48.0	43.5
JCA20-rd	17	96	21094	21364	Roadway	780.1		0.7	3.8	7.0	7.4	42.0	40.5	42.0	40.5	42.1	41.2	42.2	42.2	43.4	43.4	48.0	43.5
JCA10	18	97	21364	25213	24-in Dia	696.0	25	19.4	22.1	22.6	22.2	26.6	25.9	38.2	32.0	41.2	33.3	42.2	34.0	43.4	35.5	43.5	44.0
System #6																							
KC60.1	154	186	41069	41064	18-in Dia	791.4	25	5.4	6.2	6.1	6.2	96.3	91.6	99.8	98.3	100.1	98.7	100.2	98.7	100.3	98.8	101.0	103.0
KC60-rd	155	187	41069	41064	Roadway	791.4		0.0	0.0	0.0	0.0	100.0	102.0	99.8	99.8	100.1	100.1	100.2	100.2	100.3	100.3	101.0	103.0
KC50b.1	156	188	41065	41064	18-in Dia	420.4	25	2.7	3.0	2.6	3.1	95.4	91.6	98.3	98.3	98.7	98.7	98.8	98.7	98.9	98.8	99.0	103.0
KC50b-rd	157	189	41065	41064	Roadway	420.4		0.0	0.0	0.0	0.0	98.0	102.0	98.3	98.3	98.7	98.7	98.8	98.8	98.9	98.9	99.0	103.0
KC50a	158	190	41064	41031	24-in Dia	318.8	25	5.8	6.4	6.7	6.9	91.6	89.7	98.3	98.3	98.7	98.5	98.7	98.5	98.8	98.6	103.0	103.5

Structure ID	Model Sequence	Summary Sequence	Node ID		Structure Size/Type	Structure Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions				Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)								Ground Elevation (ft)	
			US	DS				10-Year	25-Year	50-Year	100-Year	US	DS	10-Year US	10-Year DS	25-Year US	25-Year DS	50-Year US	50-Year DS	100-Year US	100-Year DS	US	DS
KC40b.1	159	191	41032	41031	18-in Dia	383.6	25	-7.6	-7.7	-8.1	-8.0	93.3	89.7	98.3	98.3	98.5	98.5	98.6	98.5	98.7	98.6	99.0	103.5
KC40b-rd	160	192	41032	41031	Roadway	383.6		0.0	0.0	0.0	0.0	96.0	100.5	98.3	98.3	98.5	98.5	98.6	98.6	98.7	98.7	99.0	103.5
KC40a	161	193	41031	41029	24-in Dia	233.6	25	7.4	7.2	8.2	8.9	89.7	88.8	98.3	98.2	98.5	98.3	98.5	98.3	98.6	98.3	103.5	99.0
KC30b.1	162	194	41029	41109	18-in Dia	164.0	25	7.2	6.7	6.8	6.4	88.8	87.1	98.2	98.1	98.3	98.2	98.3	98.2	98.3	98.3	99.0	99.0
KC30b-rd	163	195	41029	41109	Roadway	164.0		2.1	4.5	5.3	6.0	98.0	98.0	98.2	98.1	98.3	98.2	98.3	98.2	98.3	98.3	99.0	99.0
KC30a.1	164	196	41109	21101	18-in Dia	1029.0	25	10.9	11.0	10.6	10.4	87.1	83.7	98.1	92.2	98.2	92.3	98.2	92.3	98.3	92.3	99.0	93.6
KC30a-rd	165	197	41109	21101	Roadway	1029.0		4.7	10.0	13.3	16.6	98.0	92.1	98.1	92.2	98.2	92.3	98.2	92.3	98.3	92.4	99.0	93.6
KC10b.1	166	198	21101	41005	18-in Dia	2119.0	25	15.5	15.5	15.5	15.5	82.7	39.4	92.2	43.2	92.3	45.8	92.3	46.2	92.3	46.8	93.6	47.0
KC10b-rd	167	199	21101	41005	Roadway	2119.0		6.1	15.9	22.5	28.2	92.1	45.5	92.2	45.6	92.3	45.8	92.3	46.2	92.3	46.8	93.6	47.0
KC10a	168	200	41005	41006	21-in Dia	239.0	25	21.0	25.5	26.1	27.3	39.4	36.9	43.2	38.5	45.8	38.7	46.2	38.7	46.8	40.0	47.0	45.0
KC20c.1	169	201	41020	41006	15-in Dia	1791.0	25	8.9	9.0	8.9	8.6	67.0	33.8	72.1	35.0	72.1	35.1	72.1	37.3	72.2	40.0	73.0	45.0
KC20c-rd	170	202	41020	41006	Roadway	1791.0		3.9	7.2	9.9	12.3	72.0	44.0	72.1	44.1	72.1	44.1	72.1	44.1	72.2	44.2	73.0	45.0
KC20a	171	203	41006	45017	21-in Dia	64.0	25	33.8	41.4	44.1	44.4	33.8	24.0	35.0	25.0	35.1	27.2	37.3	29.9	40.0	32.8	45.0	40.0
System #7																							
WRA30e.1	1	250	11003	15009	18-in Dia	883.0	25	7.3	7.7	8.1	8.1	54.0	50.5	60.2	50.9	60.2	50.9	60.3	51.0	60.3	51.0	64.0	60.0
WRA30e-rd	2	251	11003	15009	Roadway	883.0		5.0	7.5	14.2	17.1	60.0	56.0	60.2	56.1	60.2	56.2	60.3	56.2	60.3	56.3	64.0	60.0
WRA30d	3	252	15009	12055	Natural	70.0	25/NA	12.3	15.2	62.0	118.9	50.5	38.7	50.9	41.6	50.9	43.6	51.0	46.1	51.0	45.8	60.0	54.0
WRA30c	4	253	12055	15000	18-in Dia	286.8	25	12.0	14.3	15.9	16.2	38.7	37.2	41.6	38.3	43.6	38.2	46.1	38.1	45.8	38.1	54.0	41.0
WRA30b	5	254	15000	104	Natural	677.0	25/NA	11.9	14.4	15.0	15.8	37.2	27.5	38.3	27.7	38.2	28.2	38.1	30.2	38.1	32.0	41.0	32.0
WRA30a	6	255	104	15005	36-in Dia	168.6	25	11.9	14.4	14.7	-23.5	27.5	15.0	27.7	23.6	28.2	27.2	30.2	29.9	32.0	32.8	32.0	33.0
System #8																							
MSC10b.1	138	183	42292	41033	18-in Dia	461.6	25	4.6	7.2	9.5	11.3	92.0	79.8	92.7	80.2	92.9	80.3	93.1	80.4	93.3	80.4	97.0	89.0
MSC10b-rd	139	184	42292	41033	Roadway	461.6		0.0	0.0	0.0	0.0	96.0	88.0	80.2	80.2	80.3	80.3	80.4	80.4	80.4	80.4	97.0	89.0
MSC10a	140	185	41033	45009	24-in Dia	677.8	25	4.6	7.2	9.5	11.3	79.8	32.0	80.2	32.4	80.3	32.5	80.4	32.6	80.4	32.9	89.0	55.0
System #9																							
MSC40d.1	116	170	41091	42097	15-in Dia	1138.5	25	5.1	5.5	5.8	6.0	126.4	114.3	128.6	115.0	128.6	115.1	128.6	115.2	128.6	115.2	129.5	121.5
MSC40d-rd	117	171	41091	42097	Roadway	1138.5		1.4	2.9	4.5	5.5	128.5	120.5	128.6	120.6	128.6	120.6	128.6	120.6	128.6	120.6	129.5	121.5
MSC40c	118	172	42097	41042	18-in Dia	1099.7	25	6.5	8.4	12.0	12.4	114.3	83.6	115.0	84.3	115.1	85.2	115.2	87.8	115.2	88.3	121.5	90.0
MSC40b	119	173	41042	41043	18-in Dia	92.9	25	6.4	7.9	10.6	11.3	83.6	81.5	84.3	83.5	85.2	84.5	87.8	86.7	88.3	87.1	90.0	90.0
MSC40a	120	174	41043	41044	18-in Dia	264.4	25	6.3	7.9	10.6	11.2	81.5	80.5	83.5	81.1	84.5	81.2	86.7	81.3	87.1	81.3	90.0	88.0
MSC30	121	175	41045	41044	18-in Dia	147.7	25	-0.8	-1.0	-1.3	-1.4	80.3	80.5	81.2	81.1	81.3	81.2	81.4	81.3	81.4	81.3	86.2	88.0
MSC20c	122	176	41044	41048	30-in Dia	447.1	25	7.1	8.8	11.5	12.3	80.5	72.7	81.1	73.5	81.2	73.6	81.3	73.7	81.3	73.8	88.0	78.0
MSC60b	123	177	41055	41054	18-in Dia	103.2	25	4.3	5.3	6.2	6.9	77.9	77.9	79.6	79.4	80.0	79.8	80.4	80.1	80.7	80.4	82.0	83.0
MSC60a	124	178	41054	41053	18-in Dia	121.4	25	-4.3	-5.3	-6.2	-6.9	77.9	78.0	79.4	78.6	79.8	78.6	80.1	78.7	80.4	78.7	83.0	86.0
MSC50c	125	179	41079	41076	15-in Dia	1210.1	25	1.4	1.8	2.1	2.3	79.7	73.3	80.0	78.6	80.2	78.7	80.3	78.7	80.4	78.8	84.0	80.0
MSC50b	126	180	41076	41075	18-in Dia	90.1	25	-1.4	-1.8	-2.1	-2.3	73.3	75.8	78.6	78.6	78.7	78.6	78.7	78.7	78.8	78.7	80.0	80.0
MSC50a	127	181	41075	41053	24-in Dia	118.5	25	-1.5	-1.8	-2.1	-2.3	75.8	78.0	78.6	78.6	78.6	78.6	78.7	78.7	78.7	78.7	80.0	86.0
MSC20b	128	182	41053	41048	24-in Dia	228.9	25	5.3	6.6	7.7	8.5	78.0	72.7	78.6	73.5	78.6	73.6	78.7	73.7	78.7	73.8	86.0	78.0
MSC20a	129	182	41048	45010	30-in Dia	1299.7	25	14.6	17.9	21.4	24.3	72.7	35.0	73.5	35.8	73.6	35.9	73.7	36.0	73.8	36.1	78.0	45.0
System #10																							
MSC80	103	167	41063	43000	21-in Dia	651.8	25	3.3	4.1	4.8	5.3	86.8	80.3	87.4	81.4	87.4	81.6	87.5	81.7	87.5	81.8	92.0	87.0
MSC70b	104	168	43000	41074	21-in Dia	231.3	25	5.4	6.7	7.8	8.7	80.3	79.3	81.4	79.8	81.6	79.8	81.7	79.9	81.8	79.9	87.0	89.0
MSC70a	105	169	41074	45013	21-in Dia	428.6	25	5.4	6.7	7.8	8.7	79.3	55.0	79.8	55.5	79.8	55.5	79.9	55.6	79.9	55.6	89.0	60.0
System #11																							
MSC110b	93	162	41099	41100	15-in Dia	619.2	25	2.4	3.0	3.5	3.9	96.8	86.1	97.3	86.5	97.4	86.6	97.4	86.7	97.4	86.7	103.5	91.0
MSC110a	94	163	41100	41101	17-in Dia	47.4	25	2.4	3.0	3.5	3.9	86.1	85.3	86.5	86.2	86.6	86.3	86.7	86.4	86.7	86.5	91.0	91.8
MSC100	95	164	42201	41101	15-in Dia	482.5	25	1.4	1.7	2.0	2.2	94.8	85.3	95.1	86.2	95.2	86.3	95.2	86.4	95.2	86.5	98.0	91.8
MSC90b	96	165	41101	41103	21-in Dia	460.7	25	8.1	10.1	11.9	13.2	85.3	79.6	86.2	80.6	86.3	80.7	86.4	80.9	86.5	81.0	91.8	86.0

Structure ID	Model Sequence	Summary Sequence	Node ID		Structure Size/Type	Structure Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions				Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)								Ground Elevation (ft)	
														10-Year		25-Year		50-Year		100-Year			
			US	DS				10-Year	25-Year	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
MSC90a	97	166	41103	45014	24-in Dia	710.9	25	8.1	10.1	11.8	13.1	79.6	75.0	80.6	76.0	80.7	76.1	80.9	76.2	81.0	76.3	86.0	80.0
System #12																							
MSB20e.1	57	144	61105	61010	24-in Dia	888.6	25	15.9	18.5	18.5	18.5	80.8	80.6	87.7	82.8	90.0	83.2	90.1	83.5	90.2	83.8	91.0	87.0
MSB20e-rd	58	145	61105	61010	Roadway	888.6		0.0	0.4	3.9	6.9	90.0	86.0	82.8	82.8	90.0	86.0	90.1	86.1	90.2	86.2	91.0	87.0
MSB20d	59	146	61010	61028	24-in Dia	79.0	25	-15.9	-18.8	-22.0	-24.7	80.6	80.8	82.8	82.1	83.2	82.2	83.5	82.4	83.8	82.5	87.0	86.0
MSB20c	60	147	61028	61032	48-in Dia	1134.8	25	15.8	18.8	22.0	24.6	80.8	77.9	82.1	79.9	82.2	80.0	82.4	80.2	82.5	80.3	86.0	87.0
MSB20b	61	148	61032	65029	54-in Dia	357.7	25	15.7	18.9	21.9	24.5	77.9	77.4	79.9	78.4	80.0	78.6	80.2	78.8	80.3	79.0	87.0	84.0
MSB20a	62	149	65029	65032	Natural	41.8	25/NA	15.6	18.8	21.7	24.2	77.4	77.3	78.4	78.2	78.6	78.5	78.8	78.7	79.0	79.0	84.0	89.0
MSB30c.1	63	150	66003	61027	48-in Dia	2226.2	25	16.8	20.1	23.6	27.6	80.0	79.4	83.4	81.2	84.2	81.4	85.2	81.6	86.2	81.8	89.0	87.0
MSB30c-rd	64	151	66003	61027	Roadway	2226.2		0.0	0.0	0.0	0.0	88.0	86.0	81.2	81.2	81.4	81.4	81.6	81.6	81.8	81.8	89.0	87.0
MSB30b.1	65	152	61027	61034	48-in Dia	1184.3	25	15.9	19.2	22.7	26.2	79.4	78.0	81.2	79.4	81.4	79.5	81.6	79.7	81.8	79.8	87.0	87.0
MSB30b-rd	66	153	61027	61034	Roadway	1184.3		0.0	0.0	0.0	0.0	86.0	86.0	79.4	79.4	79.5	79.5	79.7	79.7	79.8	79.8	87.0	87.0
MSB30a	67	154	61034	65032	48-in Dia	381.7	25	15.7	19.2	22.5	25.9	78.0	75.7	79.4	78.2	79.5	78.5	79.7	78.7	79.8	79.0	87.0	89.0
MSB10c	68	155	65032	65031	Natural	119.3	25/NA	30.3	36.9	41.8	46.1	75.7	75.6	78.2	78.2	78.5	78.4	78.7	78.7	79.0	79.0	89.0	86.0
MSC120c.1	69	156	61038	62355	15-in Dia	161.8	25	4.0	4.8	5.4	5.8	96.8	94.8	99.1	95.1	100.0	95.1	100.0	95.1	100.0	95.1	101.0	99.0
MSC120c-rd	70	157	61038	62355	Roadway	161.8		0.0	0.1	0.5	0.7	100.0	98.0	95.1	95.1	100.0	98.0	100.0	98.0	100.0	98.0	101.0	99.0
MSC120b	71	158	62355	61037	18-in Dia	124.3	25	5.9	6.1	5.8	6.5	94.8	81.3	95.1	84.7	95.1	85.0	95.1	85.2	95.1	85.4	99.0	91.5
MSC120a	72	159	61037	65031	24-in Dia	145.5	25	-4.0	-5.0	-5.8	-6.5	81.3	83.5	84.7	84.2	85.0	84.3	85.2	84.4	85.4	84.4	91.5	86.0
MSB10b	73	160	65031	66007	Natural	777.0	25/NA	32.8	40.1	45.0	48.7	75.6	75.6	78.2	77.9	78.4	78.2	78.7	78.5	79.0	78.8	86.0	88.0
MSB10a	74	161	66007	65027	48-in Dia	3076.0	25	56.0	65.6	74.0	80.7	75.6	62.0	77.9	66.1	78.2	66.1	78.5	66.6	78.8	67.4	88.0	90.0
System #13																							
MSA90.1	23	125	61160	61177	24-in Dia	2523.0	25	12.4	15.3	17.7	19.4	171.1	147.7	172.1	153.6	172.4	153.6	172.7	153.7	175.7	153.7	180.0	154.5
MSA90-rd	24	126	61160	61177	Roadway	2523.0		0.0	0.0	0.0	0.0	179.0	153.5	153.6	153.6	153.6	153.6	153.7	153.7	153.7	153.7	180.0	154.5
MSA80d	22	127	61159	61177	18-in Dia	583.3	25	6.1	5.9	6.4	7.2	174.9	146.6	175.1	153.6	175.1	153.6	175.1	153.7	175.1	153.7	178.8	154.5
MSA80c.1	25	128	61177	61148	24-in Dia	253.4	25	-14.6	-12.5	-14.7	-14.6	146.6	146.9	153.6	152.6	153.6	152.6	153.7	152.7	153.7	152.7	154.5	153.0
MSA80c-rd	26	129	61177	61148	Roadway	253.4		2.3	6.1	9.4	12.1	153.5	152.0	153.6	152.6	153.6	152.6	153.7	152.7	153.7	152.7	154.5	153.0
MSA80b.1	27	130	61148	61179	15-in Dia	242.5	25	5.2	5.3	5.2	5.3	146.9	146.7	152.6	152.4	152.6	152.5	152.7	152.6	152.7	152.6	153.0	153.0
MSA80b-rd	28	131	61148	61179	Roadway	242.5		13.6	17.2	20.4	23.0	152.0	152.0	152.6	152.4	152.6	152.5	152.7	152.6	152.7	152.6	153.0	153.0
MSA80A	29	132	61179	61151	18-in Dia	186.0	25	6.0	6.1	5.9	6.1	146.7	145.8	152.4	152.2	152.5	152.3	152.6	152.3	152.6	152.3	153.0	153.0
MSA80A-rd	30	133	61179	61151	Roadway	186.0		11.4	15.0	18.2	20.7	152.0	152.0	152.4	152.2	152.5	152.3	152.6	152.3	152.6	152.3	153.0	153.0
MSA70d.1	31	134	61151	65028	18-in Dia	683.6	25	8.8	9.3	9.7	10.0	145.8	142.8	152.2	143.6	152.3	143.7	152.3	143.8	152.3	143.8	153.0	150.0
MSA70d-rd	32	135	61151	65028	Roadway	683.6		11.8	16.2	20.3	23.4	152.0	149.0	152.2	149.2	152.3	149.3	152.3	149.3	152.3	149.3	153.0	150.0
MSA70c	33	136	65028	66010	Natural	1110.5	25/NA	20.6	25.5	30.0	33.4	142.8	106.0	143.6	107.0	143.7	107.1	143.8	107.3	143.8	107.4	150.0	109.0
MSA70b	34	137	66010	65034	30-in Dia	54.9	25	20.6	25.5	29.9	33.3	106.0	104.0	107.0	105.0	107.1	105.1	107.3	105.1	107.4	105.2	109.0	107.0
MSA70a	35	138	65034	66009	Natural	174.0	25/NA	20.6	25.5	29.9	33.3	104.0	101.5	105.0	104.0	105.1	104.0	105.1	104.0	105.2	104.0	107.0	104.0
MSA20c.1	36	139	62296	65011	15-in Dia	56.0	25	2.6	2.6	2.8	2.9	102.2	102.1	104.3	104.0	104.4	104.0	104.4	104.1	104.5	104.1	107.0	107.1
MSA20C-rd	37	140	62296	65011	Roadway	56.0		-5.4	-10.1	-14.3	-17.8	104.0	104.1	104.3	104.2	104.4	104.3	104.4	104.4	104.5	104.4	107.0	107.1
MSA20b	38	141	65011	66009	Natural	29.0	25/NA	7.7	12.6	17.1	20.7	102.1	101.5	104.0	104.0	104.0	104.0	104.1	104.0	104.1	104.0	107.1	104.0
MSA20a	39	142	66009	65033	18-in Dia	59.2	25	8.0	8.0	8.0	8.0	101.5	101.5	104.0	102.6	104.0	102.6	104.0	102.6	104.0	102.6	104.0	104.0
MSA10	40	143	61052	65023	24-in Dia	2074.6	25	2.3	4.0	5.7	7.2	152.4	100.3	152.8	102.3	152.9	102.8	153.0	103.0	153.1	103.0	156.0	110.0
System #14																							
MSA50b.1	12	111	62175	62179	18-in Dia	329.0	25	5.1	8.5	12.3	14.4	88.5	80.2	89.2	80.7	89.4	82.9	89.5	83.4	89.7	83.8	94.5	85.5
MSA50b-rd	13	112	62175	62179	Roadway	329.0		0.0	0.0	0.0	0.0	92.0	83.0	80.7	80.7	82.9	82.9	83.4	83.4	83.8	83.8	94.5	85.5
MSA60b	16	113	62318	62323	15-in Dia	301.3	25	1.0	1.9	2.8	3.5	143.4	131.1	143.7	131.3	143.8	131.4	143.8	131.5	143.9	131.5	148.0	134.0
MSA60a	17	114	62323	62325	18-in Dia	322.6	25	1.0	1.9	2.8	3.5	129.7	109.3	129.9	109.5	130.0	109.6	130.0	109.7	130.1	109.7	134.0	114.5
MSA50c.1	18	115	62325	62179	18-in Dia	397.1	25	1.4	2.6	6.4	7.6	108.4	80.2	108.7	80.7	108.8	82.9	108.8	83.4	108.9	83.8	114.5	85.5
MSA50c-rd	19	116	62325	62179	Roadway	397.1		0.0	0.0	0.0	0.0	112.0	83.0	80.7	80.7	82.9	82.9	83.4	83.4	83.8	83.8	114.5	85.5
MSA50a.1	20	117	62179	61107	18-in Dia	58.8	25	7.8	11.0	14.4	17.4	80.2	76.0	80.7	79.6	82.9	82.4	83.4	83.4	83.8	83.8	85.5	85.7
MSA50a-rd	21	118	62179	61107	Roadway	58.8		0.0	0.0	39.2	53.9	83.0	82.2	79.6	79.6	82.4	82.4	83.4	83.4	83.8	83.8	85.5	85.7
MSA30c	47	119	62290	62284	15-in Dia	490.4	25	3.7	4.6	5.4	6.0	89.5	80.8	90.3	81.2	90.4	82.4	90.5	83.5	90.7	83.9	93.0	86.0

Structure ID	Model Sequence	Summary Sequence	Node ID		Structure Size/Type	Structure Length (ft)	Design Storm	Peak Flow (cfs) Existing Land Use Conditions				Invert Elevation (ft)		Water Surface Elevation under Existing Land Use Conditions (ft)								Ground Elevation (ft)	
														10-Year		25-Year		50-Year		100-Year			
			US	DS				10-Year	25-Year	50-Year	100-Year	US	DS	US	DS	US	DS	US	DS	US	DS	US	DS
MSA30b.1	48	120	62284	62282	18-in Dia	47.4	25	3.7	4.6	5.4	6.1	80.8	78.7	81.2	79.6	82.4	82.4	83.5	83.4	83.9	83.9	86.0	85.5
MSA30b-rd	49	121	62284	62282	Roadway	47.4		0.0	0.0	5.3	5.4	82.5	82.0	79.6	79.6	82.4	82.4	83.5	83.4	83.9	83.9	86.0	85.5
MSA30a.1	50	122	62282	61107	20.04-in Dia	194.8	25	3.7	4.6	5.4	6.1	78.7	76.0	79.6	79.6	82.4	82.4	83.4	83.4	83.9	83.8	85.5	85.7
MSA30a-rd	51	123	62282	61107	Roadway	194.8		0.0	-1.1	-8.9	-14.2	82.0	82.2	79.6	79.6	82.4	82.4	83.4	83.4	83.9	83.8	85.5	85.7
MSA40	52	124	61107	65015	24-in Dia	62.5	25	38.8	54.5	59.2	61.2	76.0	74.6	79.6	76.6	82.4	76.6	83.4	76.6	83.8	76.6	85.7	90.0
System #15																							
MSA100f.1	4	100	61115	61118	15-in Dia	233.5	25	11.0	10.9	10.8	10.7	112.8	111.9	122.9	122.3	123.0	122.3	123.1	122.3	123.2	122.4	124.5	123.2
MSA100f-rd	5	101	61115	61118	Roadway	233.5		17.3	24.6	30.7	35.6	122.5	122.2	122.9	122.5	123.0	122.6	123.1	122.6	123.2	122.7	124.5	123.2
MSA100e.1	6	102	61118	62166	15-in Dia	286.6	25	14.4	14.6	14.6	14.6	111.8	104.1	122.3	105.3	122.3	107.1	122.3	107.1	122.4	107.1	123.2	108.0
MSA100e-rd	7	103	61118	62166	Roadway	286.6		6.0	14.1	20.3	25.2	122.2	107.0	122.3	107.1	122.3	107.1	122.3	107.1	122.4	107.2	123.2	108.0
MSA100d.1	8	104	62166	62171	18-in Dia	270.5	25	20.4	23.3	23.3	23.3	103.2	92.2	104.5	96.1	107.1	96.1	107.1	96.2	107.1	96.2	108.0	97.0
MSA100d-rd	9	105	62166	62171	Roadway	270.5		0.0	4.5	10.7	15.6	107.0	96.0	96.1	96.1	107.1	96.1	107.1	96.2	107.1	96.2	108.0	97.0
MSA100c.1	10	106	62171	62175	18-in Dia	188.0	25	13.4	15.4	16.6	17.8	92.2	88.5	96.1	89.2	96.1	89.4	96.2	89.5	96.2	89.7	97.0	94.5
MSA100c-rd	11	107	62171	62175	Roadway	188.0		6.9	12.8	17.9	21.3	96.0	92.0	96.1	92.1	96.1	92.1	96.2	92.2	96.2	92.2	97.0	94.5
MSA100b.1	14	108	62175	62174	18-in Dia	38.4	25	15.3	21.2	23.0	25.2	88.5	82.9	89.2	84.2	89.4	84.6	89.5	84.7	89.7	85.0	94.5	93.8
MSA100b-rd	15	109	62175	62174	Roadway	38.4		0.0	0.0	0.0	0.0	92.0	92.8	89.2	89.2	89.4	89.4	89.5	89.5	89.7	89.7	94.5	93.8
MSA100a	173	110	62174	65016	24-in Dia	87.1	25	15.3	21.2	23.0	25.2	82.9	82.0	84.2	83.3	84.6	83.6	84.7	83.7	85.0	83.8	93.8	91.0

APPENDIX C

CAPITAL IMPROVEMENT PROJECT HYDROLOGIC SUMMARY TABLES

Appendix C

MAJOR HYDROLOGIC INPUT DATA FOR MILWAUKIE STORM DRAINAGE SYSTEM

Node	Subbasin Name	Subbasin Area (acres)	Impervious Area (%)	Average Subbasin Slope (ft/ft)	Pervious Curve Number CN
34089	MD100	5.3	28.0	0.009	50
35+08	MD120	60.0	41.5	0.008	53
34047	MD90	7.3	30.3	0.004	59
34033	MD80	6.7	28.0	0.012	50
34031	MD60	9.1	30.4	0.009	53
34030	MD40	5.5	28.0	0.006	59
34045&46	MD70	4.6	34.4	0.001	59
34034	MD50	5.2	28.0	0.005	59
34147	MD20	13.8	28.0	0.004	55
11+65	MD30	7.7	28.0	0.002	59
31019	JCD70	20.6	28.0	0.007	59
31024	JCD80	60.9	29.4	0.009	54
33023	JCD50	19.6	28.8	0.014	60
33031	JCD60	17.5	28.0	0.003	59
21290	JCD20	7.3	28.0	0.009	53
21501	JCD40	15.3	28.6	0.006	59
21515	JCD30	14.1	28.0	0.004	57
21520	JCD10	5.8	39.5	0.020	57
301	JCC10	36.2	52.0	0.007	54
21002	JCC50	13.5	32.9	0.003	50
21015	JCC100	27.9	29.8	0.005	58
21021	JCC70	16.3	29.3	0.005	58
21024	JCC80	4.0	34.1	0.002	59
21035	JCC60	22.8	28.0	0.004	56
21037	JCC40	5.4	44.0	0.008	49
21039	JCC30	14.5	44.2	0.008	49
21267	JCC20	19.6	44.6	0.018	54
22102	JCC110	24.3	29.2	0.007	51
25019	JCC90	62.0	32.5	0.013	50
31003	JCC120	31.4	28.2	0.002	59
21066	JCB20	15.6	52.0	0.005	50
21265	JCB10	35.2	52.0	0.005	64
22413	JCB30	15.6	52.0	0.003	49
21148	JCA52	37.1	36.9	0.010	50
21187	JCA60	49.1	42.4	0.007	49
21340	JCA41	22.0	44.6	0.010	56

Node	Subbasin Name	Subbasin Area (acres)	Impervious Area (%)	Average Subbasin Slope (ft/ft)	Pervious Curve Number CN
62054	MSA20	42.9	29.3	0.007	50
61107	MSA40	5.8	40.0	0.016	50
62290	MSA30	12.7	41.9	0.016	49
62318	MSA60	17.4	28.0	0.004	50
62325	MSA50	6.5	30.1	0.004	49
61115	MSA100	49.8	28.7	0.007	67
61115	MSA110	66.3	28.3	0.006	67

* Subbasin JCA50 for Existing Conditions
* Subbasin JCA40 for Existing Conditions
* Subbasin MSA20 for Existing Conditions

APPENDIX D

CAPITAL IMPROVEMENT PROJECT HYDRAULIC SUMMARY TABLES

Appendix D

HYDRAULIC PERFORMANCE OF MILWAUKIE STORM DRAINAGE SYSTEM UNDER EXISTING LAND USE CONDITIONS

Structure ID	Node ID		Structure Size/Type	Structure Length (ft)	Design Storm	Peak Flow (cfs)	Invert Elevation (ft)		Water Surface Elevation 25-Year		Ground Elevation (ft)	
	US	DS				25-Year	US	DS	US	DS	US	DS
System #1												
JDC80b.1	31024	22673	18-in Dia	282.1	25	8.3	119.3	119.0	121.8	120.0	125.0	124.0
JDC80b-rd	31024	22673	Roadway	282.1		0.0	124.0	122.0	120.0	120.0	125.0	124.0
JDC80a.1	22673	33039	18-in Dia	786.4	25	8.3	119.0	109.9	120.0	111.7	124.0	115.3
JDC80a-rd	22673	33039	Roadway	786.4		0.0	123.0	114.3	111.7	111.7	124.0	115.3
JDC70d.1	31019	31018	18-in Dia	177.3	25	5.2	152.9	151.5	153.8	153.1	157.0	157.0
JDC70d-rd	31019	31018	Roadway	177.3		0.0	156.0	156.0	153.1	153.1	157.0	157.0
JDC70c	31018	33033	18-in Dia	241.9	25	5.2	151.5	151.4	153.1	152.3	157.0	156.0
JDC70b	33033	33039	24-in Dia	923.8	25	5.2	151.1	110.1	151.5	111.7	156.0	115.3
JDC70a.1	33039	33040	24-in Dia	370.2	25	10.9	109.7	109.4	111.7	110.6	115.3	115.0
JDC70a-rd	33039	33040	Roadway	370.2		0.0	114.3	114.0	110.2	110.2	115.3	115.0
JCD50c	33040	33043	24-in Dia	493.8	25	10.9	109.2	104.1	110.2	107.0	115.0	113.5
JCD50b	33043	33023	36-in Dia	476.2	25	10.9	106.0	104.4	107.0	106.0	113.5	111.0
MD20b	34147	14+16	12-in Dia	815.0	25	2.1	149.4	147.8	151.4	149.4	158.0	152.8
MD100	34089	35+08	12-in Dia	250.0	25	0.7	150.5	150.0	152.9	152.9	168.0	158.0
MD120	35+08	34047	24-in Dia	615.0	25	17.0	149.0	148.4	152.9	150.1	158.0	152.0
MD90	34047	34045&46	36-in Dia	407.0	25	18.5	147.4	147.0	150.1	150.0	152.0	154.0
MD80b	34033	34032	12-in Dia	240.0	25	0.8	151.8	151.3	153.1	153.0	166.0	160.0
MD80a	34032	34031	12-in Dia	665.0	25	0.9	151.3	150.0	153.0	152.8	160.0	155.0
MD60b	34031	800	12-in Dia	50.0	25	2.3	150.0	149.9	152.8	152.6	155.0	155.0
MD40	34030	800	12-in Dia	235.0	25	1.4	150.5	150.0	152.8	152.6	154.0	155.0
MD60a	800	34045&46	12-in Dia	425.0	25	3.3	149.9	149.0	152.6	150.0	155.0	154.0
MD70	34045&46	21+81	36-in Dia	305.0	25	22.2	147.0	146.7	150.0	149.8	154.0	155.2
MD50d	34034	21+81	12-in Dia	165.0	25	1.3	149.1	148.7	149.9	149.8	154.0	155.2
MD50c	21+81	18+78	36-in Dia	303.0	25	23.0	146.7	146.4	149.8	149.6	155.2	154.7
MD50b	18+78	15+02	36-in Dia	376.0	25	22.2	146.3	145.9	149.6	149.4	154.7	152.7
MD50a	15+02	14+16	36-in Dia	86.0	25	21.6	145.8	145.8	149.4	149.4	152.7	152.8
MD20a	14+16	11+65	36-in Dia	251.0	25	22.1	145.8	145.5	149.4	149.2	152.8	156.0
MD30c	11+65	8+58	36-in Dia	308.0	25	22.9	145.5	145.2	149.2	148.9	156.0	159.7
MD30b	8+58	8+36	36-in Dia	22.0	25	22.4	144.2	144.1	148.9	148.9	159.7	159.4
MD30a	8+36	33031	36-in Dia	836.0	25	21.6	145.1	144.2	148.9	148.3	159.4	157.0
JDC60	33031	33025	36-in Dia	907.6	25	22.5	144.1	143.5	148.3	144.1	157.0	154.0
JCD50e	33025	33024	24-in Dia	262.9	25	22.5	143.5	104.6	144.1	106.3	154.0	110.0

Structure ID	Node ID		Structure Size/Type	Structure Length (ft)	Design Storm	Peak Flow (cfs)	Invert Elevation (ft)		Water Surface Elevation 25-Year		Ground Elevation (ft)	
	US	DS				25-Year	US	DS	US	DS	US	DS
Roswell Outlet												
JCC20a	25245	21267	30-in Dia	55.33	25	20.3	52.5	51.1	53.8	51.7	60.0	61.5
JCC10b.1	21267	301	42-in Dia	1323.9	25	22.7	51.1	38.1	51.7	47.3	61.5	48.5
JCC10b-rd	21267	301	Roadway	1323.9		0.0	59.0	46.0	47.3	47.3	61.5	48.5
JCC10a	301	25237	48-in Dia	242	25	27.0	38.1	35.7	47.3	47.2	48.5	50.0
System #4												
JCB10d.1	21265	21059	24x36-in Dia	306.7	25	19.3	37.7	35.0	40.3	36.4	42.0	43.0
JCB10d-rd	21265	21059	Roadway	306.7		0.0	40.0	41.0	40.3	40.3	42.0	43.0
JCB10c	21059	400	24-in Dia	72.5	25	19.3	35.0	34.5	36.4	35.8	43.0	41.0
JCB30b.1	22413	405	18-in Dia	410.1	25	7.6	42.3	40.3	44.7	41.2	47.0	45.2
JCB30b-rd	22413	405	Roadway	410.1		0.0	46.0	44.2	41.2	41.2	47.0	45.2
JCB30a	405	403	24-in Dia	160.3	25	7.6	40.4	38.5	41.2	40.0	45.2	43.5
JCB20c	21066	21065	18-in Dia	402.0	25	6.5	45.1	41.2	46.0	42.5	51.0	45.6
JCB20b	21065	21064	21-in Dia	318.0	25	6.5	41.2	40.0	42.5	40.7	45.6	44.0
JCB20a	21064	403	18-in Dia	68.6	25	6.5	40.0	38.6	40.7	40.0	44.0	43.5
JCB10f	403	404	30-in Dia	140.4	25	13.2	38.6	38.0	40.0	39.2	43.5	43.0
JCB10e	404	400	36-in Dia	555.5	25	13.2	37.8	34.5	38.8	35.8	43.0	41.0
JCB10b	400	26009	42-in Dia	161.4	25	32.4	34.5	31.9	35.8	34.5	41.0	41.8
JCB10a	26009	25226	36-in Dia	424.5	25	32.4	31.9	26.0	34.5	33.3	41.8	38.8
System #5												
JCA50b.1	21148	21165	15-in Dia	1212.1	25	6.4	137.4	100.0	138.0	101.1	145.0	108.0
JCA50b-rd	21148	21165	Roadway	1212.1		0.0	144.0	107.0	101.1	101.1	145.0	108.0
Meek St-1	21165	13+16	18-in Dia	26.0	25	6.4	100.0	99.9	101.1	100.9	108.0	107.5
JCA60.1	21187	21186	18-in Dia	738.3	25	11.7	162.7	120.7	163.6	121.3	167.0	125.0
JCA60-rd	21187	21186	Roadway	738.3		0.0	166.0	124.0	121.3	121.3	167.0	125.0
JCA40c	21186	21185	18-in Dia	148.2	25	11.7	120.7	110.2	121.3	111.1	125.0	119.0
JCA40b.1	21185	21340	18-in Dia	576.8	25	11.7	110.2	97.5	111.1	98.4	119.0	103.0
JCA40b-rd	21185	21340	Roadway	576.8		0.0	116.0	100.0	98.4	98.4	119.0	103.0
JCA40a.1	21340	21183	30-in Dia	509.8	25	18.5	96.5	93.6	98.4	97.8	103.0	99.0
JCA40a-rd	21340	21183	Roadway	509.8		0.0	100.0	98.0	97.8	97.8	103.0	99.0
32Ave-2	21183	21169-2	30-in Dia	420.0	25	18.4	93.6	93.2	97.8	97.1	99.0	103.0
32Ave-2-RD	21183	21169-2	12-in Dia	420.0	25	0.0	98.0	102.0	97.8	97.8	99.0	103.0
32Ave	21169-2	13+16	30-in Dia	700.0	25	25.8	93.2	92.5	97.1	95.1	103.0	107.5
32Ave-RD	21169-2	13+16	Roadway	700.0		0.0	102.0	106.5	97.1	97.1	103.0	107.5
Meek St	13+16	0+00	36-in Dia	1316.0	25	30.7	92.0	90.0	95.1	91.8	107.5	94.0
JCA50a.1	21169	21171	18-in Dia	234.0	25	3.1	95.1	92.4	95.8	92.8	103.0	102.5
JCA50a-rd	21169	21171	Roadway	285.0		0.0	102.0	98.5	92.8	92.8	103.0	102.5

Structure ID	Node ID		Structure Size/Type	Structure Length (ft)	Design Storm	Peak Flow (cfs)	Invert Elevation (ft)		Water Surface Elevation 25-Year		Ground Elevation (ft)	
	US	DS				25-Year	US	DS	US	DS	US	DS
MSC10b-rd	42292	41033	Roadway	461.6		0.0	96.0	88.0	80.3	80.3	97.0	89.0
MSC10a	41033	45009	24-in Dia	677.8	25	7.2	79.8	32.0	80.3	32.5	89.0	55.0
System #9												
MSC40d.1	41091	42097	18-in Dia	1138.5	25	8.8	126.0	114.3	127.1	115.1	129.5	121.5
MSC40d-rd	41091	42097	Roadway	1138.5		0.0	128.5	120.5	115.1	115.1	129.5	121.5
MSC40c	42097	41042	18-in Dia	1099.7	25	8.7	114.3	83.6	115.1	85.5	121.5	90.0
MSC40b	41042	41043	18-in Dia	92.9	25	8.3	83.6	81.5	85.5	84.8	90.0	90.0
MSC40a	41043	41044	18-in Dia	264.4	25	8.3	81.5	80.5	84.8	81.2	90.0	88.0
MSC30	41045	41044	18-in Dia	147.7	25	-1.0	80.3	80.5	81.3	81.2	86.2	88.0
MSC20c	41044	41048	30-in Dia	447.1	25	9.3	80.5	72.7	81.2	73.7	88.0	78.0
MSC60b	41055	41054	18-in Dia	103.2	25	5.3	77.9	77.9	80.0	79.8	82.0	83.0
MSC60a	41054	41053	18-in Dia	121.4	25	-5.3	77.9	78.0	79.8	78.6	83.0	86.0
MSC50c	41079	41076	15-in Dia	1210.1	25	1.8	79.7	73.3	80.2	78.7	84.0	80.0
MSC50b	41076	41075	18-in Dia	90.1	25	-1.8	73.3	75.8	78.7	78.6	80.0	80.0
MSC50a	41075	41053	24-in Dia	118.5	25	-1.8	75.8	78.0	78.6	78.6	80.0	86.0
MSC20b	41053	41048	24-in Dia	228.9	25	6.6	78.0	72.7	78.6	73.7	86.0	78.0
MSC20a	41048	45010	30-in Dia	1299.7	25	19.1	72.7	35.0	73.7	35.9	78.0	45.0
System #10												
MSC80	41063	43000	21-in Dia	651.8	25	4.1	86.8	80.3	87.4	81.6	92.0	87.0
MSC70b	43000	41074	21-in Dia	231.3	25	6.7	80.3	79.3	81.6	79.8	87.0	89.0
MSC70a	41074	45013	21-in Dia	428.6	25	6.7	79.3	55.0	79.8	55.5	89.0	60.0
System #11												
MSC110b	41099	41100	15-in Dia	619.2	25	3.0	96.8	86.1	97.4	86.6	103.5	91.0
MSC110a	41100	41101	17-in Dia	47.4	25	3.0	86.1	85.3	86.6	86.3	91.0	91.8
MSC100	42201	41101	15-in Dia	482.5	25	1.7	94.8	85.3	95.2	86.3	98.0	91.8
MSC90b	41101	41103	21-in Dia	460.7	25	10.1	85.3	79.6	86.3	80.7	91.8	86.0
MSC90a	41103	45014	24-in Dia	710.9	25	10.1	79.6	75.0	80.7	76.1	86.0	80.0
System #12												
MSB20e.1	61105	61010	24-in Dia	888.6	25	18.5	80.8	80.6	90.0	83.2	91.0	87.0
MSB20e-rd	61105	61010	Roadway	888.6		0.4	90.0	86.0	90.0	86.0	91.0	87.0
MSB20d	61010	61028	24-in Dia	79.0	25	-18.8	80.6	80.8	83.2	82.2	87.0	86.0
MSB20c	61028	61032	48-in Dia	1134.8	25	18.8	80.8	77.9	82.2	80.0	86.0	87.0
MSB20b	61032	65029	54-in Dia	357.7	25	18.9	77.9	77.4	80.0	78.6	87.0	84.0
MSB20a	65029	65032	Natural	41.8	25/NA	18.8	77.4	77.3	78.6	78.5	84.0	89.0
MSB30c.1	66003	61027	48-in Dia	2226.2	25	20.1	80.0	79.4	84.2	81.4	89.0	87.0

Structure ID	Node ID		Structure Size/Type	Structure Length (ft)	Design Storm	Peak Flow (cfs)	Invert Elevation (ft)		Water Surface Elevation 25-Year		Ground Elevation (ft)	
	US	DS				25-Year	US	DS	US	DS	US	DS
MSA20b	65011	66009	Natural	29.0	25/NA	8.2	102.0	101.5	103.4	103.4	107.1	104.0
MSA20a	66009	65033	24-in Dia	59.2	25	29.0	101.5	100.5	103.4	101.9	104.0	104.0
MSA10	61052	65023	24-in Dia	2074.6	25	4.0	152.4	100.3	152.9	102.7	156.0	110.0
System #14												
MSA50b.1	62175	62179	18-in Dia	329.0	25	7.5	88.5	80.2	89.3	80.8	94.5	85.5
MSA50b-rd	62175	62179	Roadway	329.0		0.0	92.0	83.0	80.8	80.8	94.5	85.5
MSA61c	600	62316	12-in Dia	650.0	25	1.3	148.9	146.3	149.4	146.6	152.0	148.5
MSA61b	62316	61108	12-in Dia	168.8	25	1.3	146.3	142.6	146.6	143.1	148.5	148.0
MSA61a	61108	62318	12-in Dia	136.7	25	1.3	142.3	142.1	143.1	142.5	148.0	146.0
MSA60b	62318	62323	15-in Dia	301.3		2.3	142.1	131.1	142.5	131.5	146.0	134.0
MSA60a	62323	62325	18-in Dia	322.6	25	2.3	129.7	109.3	130.0	109.6	134.0	114.5
MSA50c.1	62325	62179	18-in Dia	397.1		2.3	108.4	80.2	108.9	80.8	114.5	85.5
MSA50c-rd	62325	62179	Roadway	397.1	25	0.0	112.0	83.0	80.8	80.8	114.5	85.5
MSA50a.1	62179	61107	18-in Dia	58.8	25	10.7	80.2	76.0	80.8	78.9	85.5	85.7
MSA50a-rd	62179	61107	Roadway	58.8		0.0	83.0	82.2	78.9	78.9	85.5	85.7
MSA30c	62290	62284	15-in Dia	490.4	25	4.6	89.5	80.8	90.4	81.2	93.0	86.0
MSA30b.1	62284	62282	18-in Dia	47.4	25	4.6	80.8	78.7	81.2	79.3	86.0	85.5
MSA30b-rd	62284	62282	Roadway	47.4		0.0	82.5	82.0	79.3	79.3	86.0	85.5
MSA30a.1	62282	61107	20.04-in Dia	194.8	25	4.6	78.7	76.0	79.3	78.9	85.5	85.7
MSA30a-rd	62282	61107	Roadway	194.8		0.0	82.0	82.2	79.3	79.3	85.5	85.7
MSA40	61107	65015	30-in Dia	62.5	25	70.9	76.0	74.5	78.9	76.4	85.7	90.0
System #15												
MSA100f.1	61115	61118	24-in Dia	233.5	25	27.8	112.8	111.9	117.4	113.7	124.5	123.2
MSA100f-rd	61115	61118	Roadway	233.5		0.0	122.5	122.2	113.1	113.1	124.5	123.2
MSA100e.1	61118	62166	24-in Dia	286.6	25	27.8	111.8	103.2	113.1	104.2	123.2	108.0
MSA100e-rd	61118	62166	Roadway	286.6		0.0	122.2	107.0	104.2	104.2	123.2	108.0
MSA100d.1	62166	62171	24-in Dia	270.5	25	27.8	103.2	92.2	104.2	93.8	108.0	97.0
MSA100d-rd	62166	62171	Roadway	270.5		0.0	107.0	96.0	93.8	93.8	108.0	97.0
MSA100c.1	62171	62175	24-in Dia	188.0	25	27.8	92.2	88.5	93.8	89.3	97.0	94.5
MSA100c-rd	62171	62175	Roadway	188.0		0.0	96.0	92.0	89.3	89.3	97.0	94.5
MSA100b.1	62175	62174	18-in Dia	38.4	25	20.5	88.5	82.9	89.3	84.5	94.5	93.8
MSA100b-rd	62175	62174	Roadway	38.4		0.0	92.0	92.8	89.3	89.3	94.5	93.8
MSA100a	62174	65016	24-in Dia	87.1	25	20.5	82.9	82.0	84.5	83.6	93.8	91.0

APPENDIX E

CAPITAL IMPROVEMENT PROJECT FACT SHEETS

CIP-1

Applicable Criteria:

Name: **Brookside Storm Improvements**

Description:

Install new pipe from Rockwood St. to Rhodesa St (Brookside Storm Improvements Phase III was built in spring 2004. Construction cost were $361,485 to build 2213 ft of 36" pipe). This Capital Project will eliminate local flooding problems and will provide an opportunity to decommission drywells (34030, 34031, 34032, 34033, 34034, 34089, 34045, 34046, 34047, 34147, 64001) as required under UIC regulations because they are located within the 2-yr travel time for a domestic water well. Project elements are as follows:

1) Install 12" Dia pipe , 250' Long.
2) Install 24" Dia pipe , 615' Long.
3) Install 36" Dia pipe , 407' Long.
4) Install 12" Dia pipe , 240' Long.
5) Install 12" Dia pipe , 665' Long.
6) Install 12" Dia pipe , 50' Long.
7) Install 12" Dia pipe , 235' Long.
8) Install 12" Dia pipe , 425' Long.
9) Install 36" Dia pipe , 305' Long.
10) Install 12" Dia pipe , 165' Long.
11) Install 12" Dia pipe , 815' Long.
12) Install 24" Dia pipe , 480' Long.

Justification:

This capital project will provide increased capacity to alleviate observed local flooding problems and will provide an opportunity to decommission ten drywells to meet UIC requirements.

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : MD20, MD30, MD40, MD50, MD60, MD70, MD80, MD90, MD100, MD120

Drainage Area Served by Capital Project : 125.0 Acres
% Impervious (Existing) : 35.0

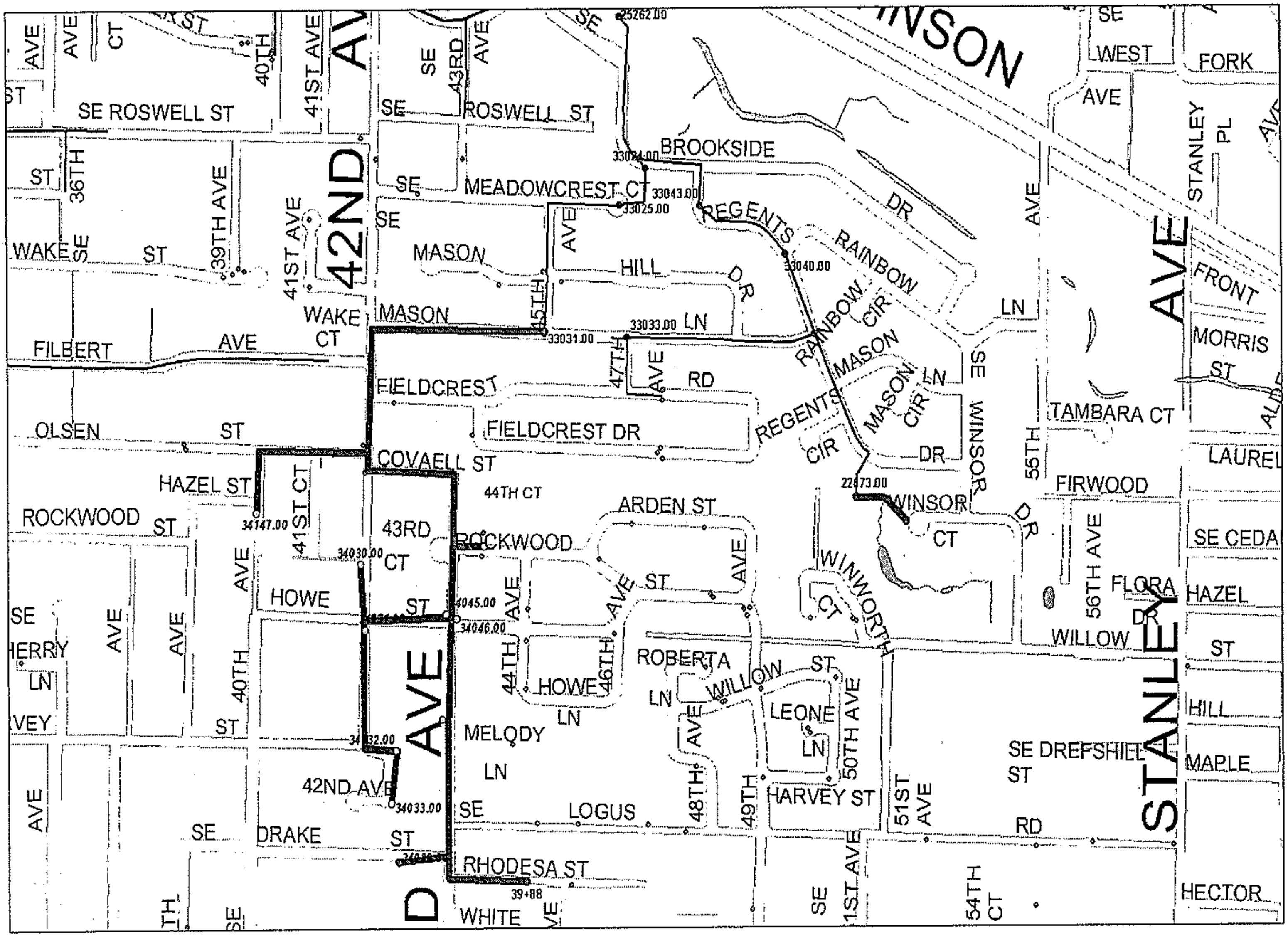
U/S Manhole 39+88
D/S Manhole 33031

Project Elelments

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
MD120a	35+08	39+88	480	ft		24" SP (8-10 ft. cover)	$ 203	$ 97,400
MD100	34089	35+08	250	ft		12" SP (16-18 ft. cover)	$ 174	$ 43,600
MD120	35+08	34047	615	ft		24" SP (8-10 ft. cover)	$ 203	$ 124,800
MD90	34047	34045&46	407	ft		36" SP (0-6 ft. cover)	$ 204	$ 83,000
MD80b	34033	34032	240	ft		12" SP (12-14 ft. cover)	$ 162	$ 38,800
MD80a	34032	34031	665	ft		12" SP (8-10 ft. cover)	$ 150	$ 100,100
MD60b	34031	800	50	ft		12" SP (0-6 ft. cover)	$ 137	$ 6,800
MD40	34030	800	235	ft		12" SP (0-6 ft. cover)	$ 137	$ 32,100
MD60a	800	34045&46	425	ft		12" SP (0-6 ft. cover)	$ 137	$ 58,100
MD70	34045&46	21+81	305	ft		36" SP (6-8 ft. cover)	$ 230	$ 70,200
MD50d	34034	21+81	165	ft		12" SP (0-6 ft. cover)	$ 137	$ 22,600
MD20b	34147	14+16	815	ft		12" SP (6-8 ft. cover)	$ 142	$ 116,100
Decommission of 11 drywells							$ 14,250	$ 156,800
						Total Construction Cost		**$ 950,400**

** Unit costs from ENR 6782*

Map:



SE ROSWELL ST
ROSWELL ST
42ND AVE
BROOKSIDE
MEADOWCREST CT
REGENTS
RAINBOW
DR
MASON
HILL
FILBERT AVE
WAKE CT
FIELDCREST
FIELDCREST DR
OLSEN ST
COVAELL ST
44TH CT
HAZEL ST
ROCKWOOD ST
43RD CT
ROCKWOOD
ARDEN ST
WINSOR CT
WINWORTH
HOWE ST
ROBERTA
WILLOW ST
HOWE LN
MELODY LN
LEONE LN
HARVEY ST
SE LOGUS RD
SE DRAKE ST
RHODESA ST
WHITE
TAMBARA CT
FIRWOOD
SE DREFSHILL ST
STANLEY AVE
MORRIS ST
LAUREL
HAZEL
HILL
MAPLE
HECTOR
55TH
56TH AVE
FLORA DR
51ST AVE
54TH CT
N

CIP-2

Applicable Criteria.

Name: **Meek St. and 32nd Ave. Pipe Improvements**

Description:
Install new pipe along Meek St. (32nd Avenue - Railroad Fence) and replace existing pipe segments along 32nd Avenue starting at Meek St. and extending to SE Monroe St. Project elements are as follows:

1) Install 36" Dia pipe , 1316' Long.
2) Install 18" Dia pipe , 26' Long.
3) Replace 12" Dia pipe with 18" Dia pipe, 577' Long.
4) Replace 15" Dia pipe with 30" Dia pipe, 510' Long.
5) Replace 15" Dia pipe with 30" Dia pipe, 420' Long.
6) Replace 15" Dia pipe with 30" Dia pipe, 700' Long.

Justification:
This capital project will provide increased capacity to alleviate observed flooding problems on SE Monroe St. and Harrison St.

Assumptions: This capital project assumes that the City of Milwaukie will conduct a study to evaluate the infiltration capacity at the pipe outfall.

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : JCA41, JCA51, JCA52, JCA60

Drainage Area Served by Capital Project : 143.6 Acres
% Impervious (Existing) : 40.1

U/S Manhole 21185
D/S Manhole 0+00

Project Elelments

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
Meek St	13+16	0+00	1316	ft		36" SP (14-16 ft. cover)	$ 333	$ 438,000
Meek St-1	21165	13+16	26	ft		18" SP (6-8 ft. cover)	$ 155	$ 4,000
JCA40b	21185	21340	577	ft	12" - Dia	18" R-SP (0-6 ft. cover)	$ 164	$ 94,500
JCA40a	21340	21183	510	ft	15" - Dia	30" R-SP (0-6 ft. cover)	$ 224	$ 114,300
32nd Ave-1	21183	21169-2	420	ft	15" - Dia	30" R-SP (6-8 ft. cover)	$ 250	$ 105,200
32nd Ave	21169-2	13+16	700	ft	15" - Dia	30" R-SP (14-16 ft. cover)	$ 357	$ 249,600

Total Construction Cost $ 1,005,600

** Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$	1,005,600
Site Acquisition	$	-
Design (20%)	$	201,100
Construction Management (14%)	$	140,800
Administration (6%)	$	80,900
Contingency (30%)	$	428,500

Capital Project Implementation Costs $ 1,856,900
Annual Maintenance Costs N/A

CIP-3

Name: SE Stanley Ave. Pipe Replacement

Applicable Criteria:

Description:

Install new pipe to connect drywells (34135, 34137, 34138, and 34153) to the existing system along SE Stanley Ave. In addition pipe replacements are required to accommodate additional flows from the drywells to be decommissioned. This Capital Project will eliminate local flooding problems and will provide an opportunity to decommission drywells as required under UIC regulations because they are located within the 2-yr travel time for a domestic water well. Project elements are as follows:

1) Install 12" Dia pipe , 340' Long.
2) Install 12" Dia pipe , 266' Long.
3) Install 12" Dia pipe , 100' Long.
4) Install 12" Dia pipe , 350' Long.
5) Replace 8" Dia pipe with 12" Dia pipe, 429' Long.
6) Replace 12" Dia pipe with 18" Dia pipe, 1017' Long.
7) Replace 12" Dia pipe with 18" Dia pipe, 132' Long.
8) Replace 8" Dia pipe with 18" Dia pipe, 94' Long.
9) Replace 12" Dia pipe with 18" Dia pipe, 282' Long.
10) Replace 15" Dia pipe with 18" Dia pipe, 56' Long.
11) Replace 18" Dia pipe with 24" Dia pipe, 59' Long.

Justification:

This capital project will provide increased capacity to alleviate observed local flooding problems and will provide an opportunity to decommission three drywells to meet UIC requirements.

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : MSA20, MSA21, MSA22, MSA23, and MSA24

Drainage Area Served by Capital Project :	78.8	Acres	U/S Manhole	34137
% Impervious (Existing) :	28.7		D/S Manhole	65033

Project Elements

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
MSA23b	34137	700	340	ft		12" SP (6-8 ft. cover)	$ 142	$ 48,400
MSA21	34135	700	266	ft		12" SP (6-8 ft. cover)	$ 142	$ 37,900
MSA23a	700	34138	100	ft		12" SP (6-8 ft. cover)	$ 142	$ 14,200
MSA22	34138	62056	350	ft		12" SP (6-8 ft. cover)	$ 142	$ 49,900
MSA24	62056	62054	429	ft	8" - Dia	12" R-SP (6-8 ft. cover)	$ 164	$ 70,200
MSA20g	62054	62305	1017	ft	12" - Dia	18" R-SP (8-10 ft. cover)	$ 186	$ 189,300
MSA20f	62305	62304	132	ft	12" - Dia	18" R-SP (10-12 ft. cover)	$ 201	$ 26,500
MSA20e	62304	62297	94	ft	8" - Dia	18" R-SP (8-10 ft. cover)	$ 186	$ 17,500
MSA20d	62297	62296	282	ft	12" - Dia	18" R-SP (8-10 ft. cover)	$ 186	$ 52,500
MSA20c	62296	65011	56	ft	15" - Dia	18" R-SP (0-6 ft. cover)	$ 164	$ 9,200
MSA20a	66009	65033	59	ft	18" - Dia	24" R-SP (0-6 ft. cover)	$ 198	$ 11,700
Decommission of 4 drywells							$ 14,250	$ 57,000
						Total Construction Cost		**$ 584,300**

** Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$	584,300
Site Acquisition	$	-
Design (20%)	$	116,900
Construction Management (14%)	$	81,800
Administration (6%)	$	47,000
Contingency (30%)	$	249,000
Capital Project Implementation Costs	$	**1,079,000**
Annual Maintenance Costs		**N/A**

CIP-4

Name: **Plum And Apple Storm Improvements**

Applicable Criteria:

Description:

Install new pipe segment along Apple St. and Juniper Ave., starting at Apple St. near Plum Dr. and extending to Aspen St. Project elements are as follows:

1) 1) Install 12" Dia pipe , 650' Long.

Justification:

This capital project will provide increased capacity to alleviate observed local flooding problems .

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : MSA30, MSA40, MSa50, MSA60, and MSA61

Drainage Area Served by Capital Project :	9.6	Acres	U/S Manhole	600
% Impervious (Existing) :	28.0		D/S Manhole	62316

Project Elelments

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
MSA61c	600	62316	650	ft		12" SP (8-10 ft. cover)	$ 150	$ 97,800

Total Construction Cost $ 97,800

** Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$	97,800
Site Acquisition	$	-
Design (20%)	$	19,600
Construction Management (14%)	$	13,700
Administration (6%)	$	7,900
Contingency (30%)	$	41,700
Capital Project Implementation Costs	**$**	**131,100**
Annual Maintenance Costs		**N/A**

CIP-5

Applicable Criteria:

Name: **Outfall to Mt. Scott Creek**

Description:

Replace pipe outfall to Mt. Scott Creek. Project elements are as follows:

1) Replace 24" pipe with 30" pipe, 63' Long.
2) Stormwater Management Stormfilter.

Justification:

This capital project will provide increased capacity to alleviate expected flooding problems on upstream pipe segment.

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : MSA30, MSA40, MSa50, MSA60, and MSA61

Drainage Area Served by Capital Project :	42.3	Acres	U/S Manhole	61107
% Impervious (Existing) :	33.2		D/S Manhole	65015

Project Elelments

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
MSA40	61107	65015	63	ft	24" - Dia	30" R-SP (8-10 ft. cover)	$ 277	$ 17,300
Stormfilter (panel Vault w/112 Cartridges)							$ 170,000	$ 170,000

Total Construction Cost $ 187,300

** Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$ 187,300
Site Acquisition	$ -
Design (20%)	$ 37,500
Construction Management (14%)	$ 26,200
Administration (6%)	$ 15,100
Contingency (30%)	$ 79,800
Capital Project Implementation Costs	**$ 345,900**
Annual Maintenance Costs	**$ 11,000**

CIP-6

Applicable Criteria:

Name: **SE King Improvements**

Description:

Install a pump station at SE King and 46th Ave. The pump station will send stormwater to the storm system located on Rhodesa St. Project elements are as follows:

1) Install 4" Dia pipe , 1160' Long.
2) Install 72" MH.
3) Install 2-1,000 gpm Pumps
4) Electrical Control Box

Justification:

This capital project will provide increased capacity to alleviate drywells located on SE King.

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : MD120

Drainage Area Served by Capital Project :	60.0	Acres	U/S Manhole	39+88
% Impervious (Existing) :	41.5		D/S Manhole	

Project Elelments

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
	Pump Station	39+88	1160	ft		4" Steel Pipe (0-4 ft. cover)	$ 80	$ 92,800
	72" MH open grate							$ 12,000
	2-1000 gpm pumps						$ 15,000	$ 30,000
	Electrical control Box							$ 13,500
							Total Construction Cost	**$ 148,300**

** Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$ 148,300
Site Acquisition	$ -
Design (20%)	$ 29,700
Construction Management (14%)	$ 20,800
Administration (6%)	$ 11,900
Contingency (30%)	$ 63,200
Capital Project Implementation Costs	**$ 273,900**
Annual Maintenance Costs	**N/A**

CIP-7

Name: **SE Lake Rd. Pipe Replacement**

Applicable Criteria:

Description:

Replace pipe segment along SE Lake Rd. This capital project will increase pipe capacity to eliminate observed local flooding problems. Project elements are as follows:

1) Replace 15" Dia pipe with 18" Dia pipe, 1139' Long.

Justification:

This capital project will provide increased capacity to alleviate expected flooding problems along SE Lake Rd.

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : MSC40

Drainage Area Served by Capital Project :	27.7	Acres	U/S Manhole	41091
% Impervious (Existing) :	28.0		D/S Manhole	42097

Project Elements

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
MSC40d	41091	42097	1139	ft	15" - Dia	18" R-SP (0-6 ft. cover)	$ 164	$ 186,600

Total Construction Cost $ 186,600

** Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$	186,600
Site Acquisition	$	-
Design (20%)	$	37,300
Construction Management (14%)	$	26,100
Administration (6%)	$	15,000
Contingency (30%)	$	79,500
Capital Project Implementation Costs	**$**	**344,500**
Annual Maintenance Costs		**N/A**

CIP-8

Applicable Criteria:

Name: **Washington St. and SE Lake Rd. Pipe Replacements**

Description:
Upsize Washington St. outfall and replace pipe segments along Washington St. and SE Lake Rd. to increase pipe capacity and eliminate expected flooding problems on Main St., Washington St., and SE Lake Rd. Project elements are as follows:

1) Replace 18" Dia pipe with 24" Dia pipe, 1029' Long.
2) Replace 18" Dia pipe with 24" Dia pipe, 2119' Long.
5) Replace 21" Dia pipe with 24" Dia pipe, 64' Long.
3) Replace 21" Dia pipe with 24" Dia pipe, 239' Long.
4) Replace 15" Dia pipe with 24" Dia pipe, 1791' Long.
6) Stormwater Management Stormfilter.

Justification:

This capital project will provide increased capacity to alleviate expected flooding problems along Main St., Washington St., and SE Lake Rd.

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : KC10, KC20, KC30, KC40, KC50, KC60

Drainage Area Served by Capital Project : 130.9 Acres
% Impervious (Existing) : 50.1

U/S Manhole 41109
D/S Manhole 45017

Project Elements

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
KC30a	41109	21101	1029	ft	18" - Dia	24" R-SP (8-10 ft. cover)	$ 233	$ 240,100
KC10b	21101	41005	2119	ft	18" - Dia	24" R-SP (8-10 ft. cover)	$ 233	$ 494,400
KC10a	41005	41006	239	ft	21" - Dia	24" R-SP (6-8 ft. cover)	$ 214	$ 51,100
KC20c	41020	41006	1791	ft	15" - Dia	24" R-SP (8-10 ft. cover)	$ 233	$ 417,900
KC20a	41006	45017	64	ft	21" - Dia	24" R-SP (8-10 ft. cover)	$ 233	$ 14,900
Stormfilter (panel Vault w/112 Cartridges)							$ 170,000	$ 170,000

Total Construction Cost $ 1,388,400

** Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$	1,388,400
Site Acquisition	$	-
Design (20%)	$	277,700
Construction Management (14%)	$	194,400
Administration (6%)	$	111,600
Contingency (30%)	$	591,600

Capital Project Implementation Costs $ 2,563,700
Annual Maintenance Costs N/A

CIP-9

Applicable Criteria:

Name: **Winsor Dr. Pipe Replacement**

Description:

Replace pipe segment along Winsor Dr. Project elements are as follows:

1) Replace 15" pipe with 18" pipe, 282' Long.

Justification:

This capital project will provide increased capacity to alleviate expected flooding problems along Winsor Dr.

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : JCD80

Drainage Area Served by Capital Project :	60.9	Acres		U/S Manhole	31024
% Impervious (Existing) :	29.4			D/S Manhole	22673

Project Elelments

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
JCD80b	31024	22673	282	ft	15" - Dia	18" R-SP (0-6 ft. cover)	$ 164	$ 46,200

Total Construction Cost $ 46,200

** Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$	46,200
Site Acquisition	$	-
Design (20%)	$	9,200
Construction Management (14%)	$	6,500
Administration (6%)	$	3,700
Contingency (30%)	$	19,700
Capital Project Implementation Costs	**$**	**61,900**
Annual Maintenance Costs		**N/A**

CIP-10

Applicable Criteria·

Name: **21st Ave. and SE Monroe St. Pipe Replacement**

Description:
Replace existing pipe segments along 21st Ave and SE Monroe St., starting at Harrison St. and extending to SE Monroe St. (east of 21st Ave). Project elements are as follows:

1) Replace 15" Dia pipe with 24" Dia pipe, 785' Long.

Justification:
This capital project will provide increased capacity to alleviate expected flooding problems on 21st Ave and SE Monroe St.

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : JCA20

Drainage Area Served by Capital Project :	19.0 Acres	U/S Manhole	21094
% Impervious (Existing) :	55.2	D/S Manhole	21364

Project Elements

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
JCA20	21094	21364	785	ft	15" - Dia	24" R-SP (6-8 ft. cover)	$ 214	$ 167,700

Total Construction Cost $ 167,700

** Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$ 167,700
Site Acquisition	$ -
Design (20%)	$ 33,500
Construction Management (14%)	$ 23,500
Administration (6%)	$ 13,500
Contingency (30%)	$ 71,500
Capital Project Implementation Costs	**$ 309,700**
Annual Maintenance Costs	**N/A**

CIP-11

Proj # Name: **Hemlock St. to Harmony Rd. Pipe Replacement**

Applicable Criteria:

Description:

Replace existing pipe segments Hemlock St. and Harmony Rd., starting at Hemlock St. and extending west of Cedar Crest Dr. Project elements are as follows:

1) Replace 15" Dia pipe with 24" Dia pipe, 234' Long.
2) Replace 15" Dia pipe with 24" Dia pipe, 287' Long.
3) Replace 18" Dia pipe with 24" Dia pipe, 271' Long.
4) Replace 18" Dia pipe with 24" Dia pipe, 188' Long.

Justification:

This capital project will provide increased capacity to alleviate expected local flooding problems from Hemlock St. to Harmony Rd.

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : MSA100, and MSA110

Drainage Area Served by Capital Project : 116.0 Acres
% Impervious (Existing) : 28.5

U/S Manhole 61115
D/S Manhole 62175

Project Elements

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
MSA100f	61115	61118	234	ft	15" - Dia	24" R-SP (8-10 ft. cover)	$ 233	$ 54,500
MSA100e	61118	62166	287	ft	15" - Dia	24" R-SP (8-10 ft. cover)	$ 233	$ 66,900
MSA100d	62166	62171	271	ft	18" - Dia	24" R-SP (0-6 ft. cover)	$ 198	$ 53,500
MSA100c	62171	62175	188	ft	18" - Dia	24" R-SP (6-8 ft. cover)	$ 214	$ 40,200

Total Construction Cost $ 215,100

* *Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$	215,100
Site Acquisition	$	-
Design (20%)	$	43,000
Construction Management (14%)	$	30,100
Administration (6%)	$	17,300
Contingency (30%)	$	91,700

Capital Project Implementation Costs $ 397,200
Annual Maintenance Costs N/A

CIP-12

Applicable Criteria:

Name: **Allowance for Future WQ Facilities**

Description:

1) Stormwater Management Stormfilter.
2) Stormwater Management Stormfilter.

Justification:

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names :

Drainage Area Served by Capital Project : Acres

% Impervious (Existing) :

U/S Manhole

D/S Manhole

Project Elelments

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
Stormfilter (panel Vault w/112 Cartridges)								$ 170,000
Stormfilter (panel Vault w/112 Cartridges)								$ 170,000

Total Construction Cost $ 340,000

** Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$	340,000
Site Acquisition	$	-
Design (20%)	$	68,000
Construction Management (14%)	$	47,600
Administration (6%)	$	27,300
Contingency (30%)	$	144,900
Capital Project Implementation Costs	**$**	**627,800**
Annual Maintenance Costs	**$**	**22,000**

CIP-13

Applicable Criteria:

Name: **Furnberg St. Pipe Replacement**

Description:

Replace existing pipe segments along Furnberg St., starting at SE Linwood Ave. and extending to SE Stanley Ave. Project elements are as follows:

1) Replace 15" Dia pipe with 24" Dia pipe, 243' Long.
2) Replace 18" Dia pipe with 24" Dia pipe, 186' Long.
3) Replace 18" Dia pipe with 30" Dia pipe, 684' Long.

Justification:

This capital project will provide increased capacity to alleviate expected flooding problems along Furnberg St. and eliminate flooding problem in segment along SE Linwood Ave.

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : MSA90, MSA80, and MSA70

Drainage Area Served by Capital Project :	87.2	Acres	U/S Manhole	61148
% Impervious (Existing) :	28.6		D/S Manhole	65028

Project Elelments

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
MSA80b	61148	61179	243	ft	15" - Dia	24" R-SP (0-6 ft. cover)	$ 198	$ 48,000
MSA80a	61179	61151	186	ft	18" - Dia	24" R-SP (0-6 ft. cover)	$ 198	$ 36,800
MSA70d	61151	65028	684	ft	18" - Dia	30" R-SP (0-6 ft. cover)	$ 224	$ 153,200
							Total Construction Cost	**$ 238,000**

** Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$	238,000
Site Acquisition	$	-
Design (20%)	$	47,600
Construction Management (14%)	$	33,320
Administration (6%)	$	19,140
Contingency (30%)	$	101,420
Capital Project Implementation Costs	**$**	**439,500**
Annual Maintenance Costs		**N/A**

CIP-14

Applicable Criteria:

Name: **18th Avenue Pipe Replacement**

Description:

Replace pipe segment along 18th Ave between Wren St and Blue Bird St. This capital project will increase the pipe capacity to eliminate expected local flooding problems. Project elements are as follows:

1) Replace 18" Dia pipe with 30" Dia pipe, 883' Long.

Justification:

This capital project will provide increased capacity to alleviate expected flooding problems along 18th Ave between Wren St and Blue Bird St .

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : WRA30

Drainage Area Served by Capital Project :	28.8	Acres	U/S Manhole	11003
% Impervious (Existing) :	44.5		D/S Manhole	15009

Project Elelments

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
WRA30e	11003	15009	883	ft	18" - Dia	30" R-SP (0-6 ft. cover)	$ 224	$ 197,900

Total Construction Cost $ 197,900

** Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$	197,900
Site Acquisition	$	-
Design (20%)	$	39,600
Construction Management (14%)	$	27,700
Administration (6%)	$	15,900
Contingency (30%)	$	84,300
Capital Project Implementation Costs	**$**	**365,400**
Annual Maintenance Costs		**N/A**

CIP-15

Applicable Criteria:

Name: **SE Milport Rd. Pipe Replacement**

Description:
Replace pipe segment along SE Milport Rd. Project elements are as follows:
1) Replace 12x24" CMP pipe with 24x36" CMP pipe, 307' Long.

Justification:
This capital project will provide increased capacity to alleviate expected flooding problems on SE Milport Rd and Main St.

Potential Water Quality Benefits:

Subbasin Properties

Subbasin names : JCB10

Drainage Area Served by Capital Project :	35.2	Acres	U/S Manhole	21265
% Impervious (Existing) :	52		D/S Manhole	21059

Project Elements

Pipe Id	From MH	To MH	Length	Unit	Existing Size	New Size and Cover	Unit Cost*	Total Cost
JCB10d	21265	21059	307	ft	12x24" - Dia	24x36" R-SP (0-6 ft. cover)	$ 235	$ 72,000

Total Construction Cost $ 72,000

** Unit costs from ENR 6782*

Maintenance Requirements

Not applicable

Costs

Construction	$ 72,000
Site Acquisition	$ -
Design (20%)	$ 14,400
Construction Management (14%)	$ 10,100
Administration (6%)	$ 5,800
Contingency (30%)	$ 30,700
Capital Project Implementation Costs	**$ 133,000**
Annual Maintenance Costs	**N/A**

APPENDIX F

UNIT COSTS FOR CIP COST ESTIMATES

City of Milwaukie

Stormwater Master Plan Update

Date: #######

Base ENR Index: 5950 September 1998 (City of Portland 1998 Facilities Plan)
Current ENR Index: 6782 December 2003 http://enr.construction.com/features/conEco/costIndexes/mostRecentIndexes.asp

		New Unit Pipe Cost Pipe Installation Construction Cost ($ / linear foot)																	
Diameter	Diameter	Depth to Invert (feet)																	
(inches)	(feet)	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
6	0.5	$139	$142	$150	$153	$157	$162	$166	$171	$177	$180	$186	$189	$195	$989	$989	$989	$989	$989
8	0.7	$139	$142	$150	$153	$157	$162	$166	$171	$177	$180	$186	$189	$195	$989	$989	$989	$989	$989
10	0.8	$139	$144	$150	$155	$160	$163	$171	$176	$180	$186	$193	$197	$202	$998	$998	$998	$998	$998
12	1.0	$137	$142	$150	$155	$162	$166	$174	$180	$186	$193	$198	$204	$211	$1,009	$1,009	$1,009	$1,009	$1,009
15	1.3	$137	$144	$155	$162	$172	$180	$189	$198	$206	$215	$225	$231	$243	$1,021	$1,021	$1,021	$1,021	$1,021
18	1.5	$142	$155	$162	$174	$181	$194	$202	$212	$221	$231	$241	$252	$261	$1,037	$1,037	$1,037	$1,037	$1,037
21	1.8	$152	$163	$177	$193	$204	$218	$230	$244	$258	$272	$286	$299	$312	$1,054	$1,054	$1,054	$1,054	$1,054
24	2.0	$172	$186	$203	$220	$234	$252	$268	$283	$299	$315	$332	$345	$362	$1,068	$1,068	$1,068	$1,068	$1,068
27	2.3	$180	$202	$221	$243	$263	$283	$301	$323	$344	$364	$383	$406	$425	$1,083	$1,083	$1,083	$1,083	$1,083
30	2.5	$195	$218	$241	$263	$286	$310	$332	$354	$377	$400	$423	$446	$468	$1,344	$1,344	$1,344	$1,344	$1,344
33	2.8	$198	$226	$248	$272	$300	$326	$345	$369	$397	$418	$448	$465	$497	$1,363	$1,363	$1,363	$1,363	$1,363
36	3.0	$204	$230	$256	$280	$308	$333	$358	$383	$409	$434	$460	$488	$513	$1,372	$1,372	$1,372	$1,372	$1,372
42	3.5	$225	$254	$287	$318	$351	$383	$414	$446	$475	$511	$540	$571	$604	$1,404	$1,404	$1,404	$1,404	$1,404
48	4.0	$266	$301	$341	$378	$418	$455	$494	$531	$570	$608	$646	$683	$723	$1,437	$1,437	$1,437	$1,437	$1,437
54	4.5	$340	$383	$427	$470	$513	$557	$600	$644	$686	$728	$773	$816	$858	$1,466	$1,466	$1,466	$1,466	$1,466
60	5.0	$424	$468	$513	$557	$601	$646	$692	$736	$782	$826	$871	$914	$960	$1,494	$1,494	$1,494	$1,494	$1,494
66	5.5	$473	$522	$577	$628	$678	$729	$783	$833	$885	$937	$987	$1,038	$1,091	$2,584	$2,584	$2,584	$2,584	$2,584
72	6.0		$623	$682	$741	$798	$856	$916	$972	$1,032	$1,087	$1,148	$1,204	$1,263	$2,612	$2,612	$2,612	$2,612	$2,612
78	6.5		$714	$780	$848	$914	$983	$1,050	$1,119	$1,185	$1,254	$1,321	$1,388	$1,456	$2,644	$2,644	$2,644	$2,644	$2,644
84	7.0		$870	$939	$1,009	$1,079	$1,148	$1,166	$1,289	$1,359	$1,428	$1,501	$1,568	$1,640	$2,674	$2,674	$2,674	$2,674	$2,674
90	7.5					$1,174	$1,282	$1,351	$1,451	$1,551	$1,603	$1,704	$1,772	$1,856	$2,705	$2,705	$2,705	$2,705	$2,705
96	8.0						$1,494	$1,549	$1,653	$1,738	$1,971	$1,927	$2,013	$2,092	$2,737	$2,766	$2,797	$2,828	$2,858
102	8.5						$1,750	$1,852	$1,925	$2,029	$2,134	$2,253	$2,326	$2,356	$2,387	$2,828	$2,858	$2,888	$2,918
108	9.0						$1,946	$2,036	$2,160	$2,249	$2,405	$2,494	$2,585	$2,616	$2,646	$2,888	$2,918	$2,949	$2,978
120	10.0							$2,290	$2,399	$2,510	$2,620	$2,650	$2,681	$2,711	$2,741	$2,949	$2,978	$3,009	$3,040
132	11.0								$2,644	$2,775	$2,842	$2,871	$2,902	$2,932	$2,962	$3,009	$3,040	$3,070	$3,100
144	12.0									$3,038	$3,059	$3,089	$3,120	$3,150	$3,180	$3,211	$3,241	$3,271	$3,301
156	13.0									$3,299	$3,276	$3,306	$3,336	$3,367	$3,397	$3,271	$3,301	$3,332	$3,363
168	14.0										$3,494	$3,524	$3,554	$3,585	$3,614	$3,332	$3,363	$3,392	$3,423

Note: The unit prices listed in this table are for new pipe construction cost. For replacement pipe, the unit may be higher. For stormwater pipe replacement, applying a 10-20 percent factor to the new pipe cost is recommended.

o:\25695413 Milwaukie SWMP Update\Pipe cost.xls

APPENDIX G

SPRING CREEK PHOTOS

Appendix G - Photos

Photo 1. Spring Creek at Washington St.; source springs and ponds

Photo 2. Dam and weir structure at outlet of source pond (Photo 1)

Photo 5 Waldorf School

Photo 6. Falls at Waldorf School

Photo 9. Scott Park pond culvert weir at outlet

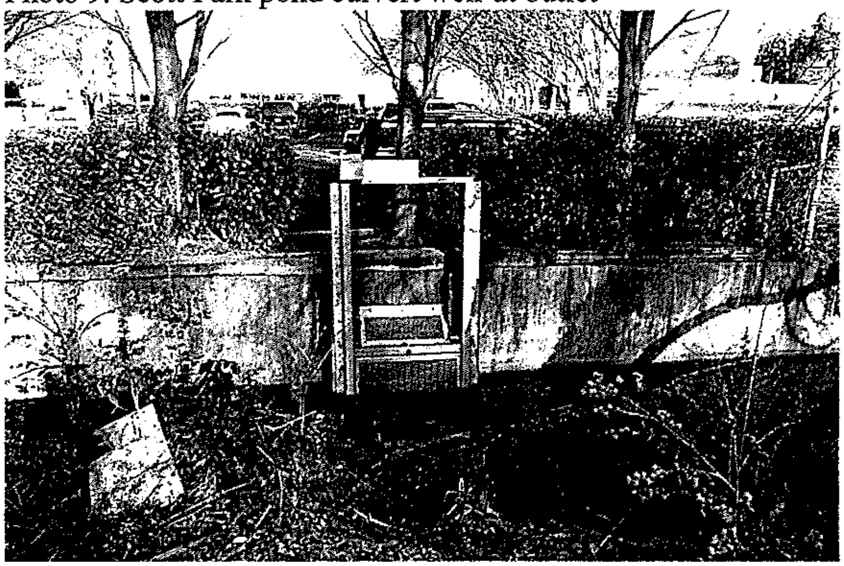


Photo 10. Submerged Spring Creek confluence (orange marker) with Johnson Creek @ approx. 100cfs.